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INTRODUCTION TO
INDUSTRIAL MANAGEMENT

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INDUSTRIAL MANAGEMENT

TEXT, CASES, AND PROBLEMS

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INTRODUCTION TO INDUSTRIAL MANAGEMENT

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To My Friends

PAMELA
CHRISTOPHER
RICHARD
JEFFREY

PREFACE

The first edition of this book appeared in 1933. At that time it was looked upon as an experiment in the textbook field. The following paragraph from the Preface to that edition indicates why that was so.

> This volume was prepared for use in those departments of economics, schools of business administration, and schools of engineering that offer introductory courses in industrial management. The primary object has been to deal with business and economic conditions as they exist in industry rather than to promulgate theories or generalities concerning them. This does not mean that the book contains no theories, for both text and case material embody business and economic principles in current use, and solution of the problems which students are asked to solve will necessitate an appreciation of sound theory. Theory, however, is never discussed for the sake of theory. Its goal always is the solution of a practical situation.

Since 1933 the shift in educational emphasis from the purely descriptive or abstract to an amalgam with "situational thinking" has accelerated constantly. Few teachers of business administration today eschew the use of problems and cases as fundamental elements of their courses. This trend has been brought about largely by the increasing emphasis on managerial aspects in business courses. Management cannot take place in a vacuum. The problems business managers must solve are situational problems. It is natural that as business education has taken on an increasing managerial focus, the vehicles of instruction increasingly emphasize concrete specific conditions.

Today problems and cases are used in college courses in a variety of ways. Most commonly, relatively concise descriptive cases are used to illustrate declaratory material. Just as pictures long have been used to clarify (and sometimes give emphasis), "caselets"—brief descriptions of business experience—have proved their worth. Such illustrative materials are common both in texts and in the professor's classroom expositions.

In many nonbusiness subjects and a few business areas, problems long have been used to reinforce student grasp and retention of technology or procedure. Initially, the student is exposed to a principle or a generalization. The instructor follows this by "working out a problem" to illustrate and make certain that the student understands. Subsequently, students are given similar problems which they must solve. This certainly is a logical sequence, and its effectiveness is confirmed by its long-standing use.

Most "combination text and case books" take advantage of this classic method of instruction. They often consist of a section of declaratory material followed by selected problems. The textual material is designed to provide "background understanding" that enables the student to undertake solution of the problems that follow with some degree of applicable knowledge.

The "pure case method" differs from the foregoing. The major emphasis is on developing skills of problem solving rather than on acquiring substantive knowledge. The latter objective, although secondary, is not unimportant. Study of well-reported business situations inevitably results in knowledge accumulation. Invariably library facilities are available and when students are urged to search this resource certain gains result that are not inherent in the usual text-problem book. The latter, of course, has the advantage of time economy; the library offers students gains of more lasting value.

From the first edition this book by means of a combination of text, case, and problem materials has endeavored to utilize the most effective elements of all three common methods of instruction. In most chapters brief declaratory introductions are illustrated and elaborated by means of a "discussed case." This case details the actual business situation, explains the problem or problems the management faced, and tells what the management did and why. The chapter concludes with a section of declaratory material that generalizes with respect to management practice in the area under consideration.

Each chapter's "Summary and Conclusions" is followed by problems for student solution. Both relatively simple and more difficult problems are included. Usually these latter are situations of greater complexity, or they involve applications in areas other than those discussed in the case. By this last means students develop a substantial degree of the problem-solving skill that is the focal objective of the "pure" case approach to learning.

Each succeeding edition of this text has included materials reflecting changes in business problems and practices. In the current volume new chapters focus attention on such concerns as automation, modern management as being composed of a series of unique skills of general applicability, and organizational trends of decentralization and recentralization. Management practices and gains in areas of increasing quantification are dealt with at many points as they emerge in new case situations that have been included. In a considerable number of cases and problems that have appeared in earlier issues we have gone back to the companies for more recent information. All these changes have tended to lengthen the book. To offset this trend a few of the chapters in earlier editions have been combined, it is believed without substantial loss of coverage or depth.

And finally the following is repeated from the Preface to the first edition:

> Centering of text material around concrete business situations necessitates a change from the conventional discussion of topics in watertight compartments. Thus, questions such as foremanship, technological unemployment, worker training, and safety are not considered as isolated abstractions but are intimately tied into the cases and problems at hand wherever they occur. For this reason, separate, detailed consideration of such topics is believed unnecessary.
>
> While text material adequate for a background for each major management topic is included, the object of the book is to force the student to think in terms of cases and problems taken from actual business life. Thus, ability to memorize becomes distinctly secondary to ability to analyze. Each has its place in the course, but there is no question as to the predominance of ability to analyze, to synthesize, and to judge.

Acknowledgment is due the Administration of the Harvard Graduate School of Business Administration for making this revision possible. Also the writer wishes to express his great appreciation for the help of Miss Barbara Kinney, whose assistance in the preparation of the manuscript has made the project feasible.

Franklin E. Folts

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PART 1

CONCEPTS OF INDUSTRIAL PRODUCTION

1

THE SIGNIFICANCE OF INDUSTRIAL PRODUCTION

Today, continuance of a "Western civilization" rests in part squarely on the ability of American industry to produce. Our factories must provide the consumables essential to a continued rise in the standard of living for a constantly increasing home population. We must produce the consumables that are an essential contribution to the progress of many of our foreign friends, allies, and potential allies who are striving for a better economic and social status. Our factories must produce the major share of the military weapons that currently appear to be the only deterrent to aggression of a few powerful men who seem bent on the destruction of all free societies. Not only must we supply ourselves with these implements of our defense, but we must produce a substantial contribution to the defense needs of those with whom we are allied in this struggle to exist.

Concurrently our industry must prepare for the day when the focus of the struggle between communism and the free societies will be economic rather than a combination of economic and military. The capacity of Russia to produce for civilian consumption increases. Relieved of the urge to establish a world-wide military superiority, the industrial establishment of the Soviets would shift to an effort to dominate the free world economically. We must anticipate this competition and prepare for it even while we deal with today's wars—cold, warm, or hot.

Our factories can produce to the satisfaction of these requirements. Of this we can be sure, and if this were the whole of the problem we need have no fear of the outcome. The difficult part of our problem is so to manage the organization and the processes of production as to assure to the consumers of this country command over the goods and services that are the products of industry. We must manage our factories in such a way as to make sure that the wealth we create can be consumed. To put it another way, the operation of our factories must be so managed as to create concurrently the products for consumption and the effective demand for the products produced. Factories can produce only if their products are consumed. Without consumption, production will cease. The creation of effective demand for consumables is as much a problem of factory management as is the production of consumables for the satisfaction of demand.

But why emphasize this dual characteristic of modern industry at this time and at this point? This function of factory production has been known and widely recognized for a long time. Today executives commonly accept this duality of function, aim, and responsibility. To date the basic reason for this acceptance has usually been belief that therein lay the best possibility of furthering the success of each individual enterprise. Growth, profits, and public recognition could best be assured through the creation of purchasing power concurrently with the creation of products for consumption.

This principle is as true today as it ever has been in the past. Now, however, there is recognition of at least two other aspects of the situation. We are beginning to understand that our factory production must contribute to the social welfare of our allied friends and neighbors as well as to that of our own people. Also we are beginning to understand that the enemies of Western civilization are counting heavily for our defeat on our inability to maintain the dual responsibility of factory production, both at home and abroad.

Industrial leaders and factory managers alone cannot provide a solution to the maintenance of a steadily increasing demand for the products of industry. There are many influential factors outside the area of industry—in fact, outside the field of business—factors over which industrial executives can exert little or no control. But this does not relieve the factory executive from his responsibility. The contribution of production management can be great, and the responsibility is commensurate.

Thus it is most essential to emphasize the importance of the United States factory and its management in the welfare of the world today and tomorrow. Two responsibilities are uppermost: production in ever-increasing volume and at ever-increasing rates per man-hour employed, and assurance to the human contributors to this production process of an ever-increasing ability to satisfy the wants of a steadily rising standard of living.

We must realize from the first how broad is the scope of the problem of industrial management. Because this book proposes to be only an introduction to the subject, no attempt will be made to establish thorough understanding of the many broad ramifications of the major problems. We can be sure, however, that if we do accomplish the more limited operating objectives we set for ourselves here we shall be making sound progress toward the fulfillment of those two major responsibilities of factory production: output of consumables and an increased ability to consume. If we discharge these two responsibilities, we shall be contributing much to assure the continued existence and progress of the kind of society that has made us an important nation in the world.

During the past decade, industry in the United States has entertained a large number of "productivity teams" from England, the European continent, and the Far East. These teams consisted of groups of experienced industrialists, engineers, and labor leaders. They came to this country at the invitation of our government. These teams were interested in studying the why and how of the high productivity of United States industry. Each team represented either a single industry, such as the drop-forging industry or the fertilizer industry, or a single type of industrial activity, such as industrial simplification, management accounting, or materials handling in factories.

Under the leadership of an American expert each team traveled extensively, studying carefully selected companies and factories throughout the United States. On returning home, each team prepared a report covering its experiences and its findings. Because these reports were written by newcomers to the United States industrial scene, they constitute some of the most penetrative and revealing literature on industrial management practices in this country. The author worked with many of these foreign groups: British, French, Scandinavian, and Japanese. The experience was reassuring in that so frequently the conclusions of these visitors confirmed the faith that American industrialists have in the management methods, procedures, and principles which have evolved from our experience and which today are so commonly accepted and applied in this country.

These principles constitute the foundation of this book. An example is Chap. 4, which discusses simplification as a basic industrial concept. In 1949, a British productivity team made a study of this concept as it is practiced in the United States. The following is from the foreword of a report published as a result of the team's findings: [1]

> *Simplification in Industry*, a report by a group appointed by the Anglo-American Council on Productivity to investigate the practice of simplification in the U.S.A. . . . outlined the contributions to high productivity and low cost which have been made by simplification in America and made recommendations for its development in British industry.
>
> The report attracted great attention. It was widely circulated and its implications were discussed by members of the group with representatives of industry in many parts of the country. These meetings took place at

---

[1] *Simplification in British Industry*, published by the Anglo-American Council on Productivity, London.

> a time when industry was actively considering how to overcome many obvious difficulties.
>
> The additional knowledge gained by members of the group in their discussions with British industrialists has strengthened their conviction that simplification is one of the main means of raising productivity and lowering cost.

In many ways the most interesting of the productivity teams that studied in this country was the Specialist Team Concerned with Education for Management. Mr. Lyndall Fownes Urwick, Chairman of Urwick, Orr & Partners, Ltd., management consultants, was the English leader of this team. The group included outstanding British industrialists, educators, and representatives of the Ministry of Education and of organized labor.

On page 19 of the report of this committee[2] one reads as follows:

> Practically every productivity team which has visited the U.S. is agreed that productivity per man-year is higher than in Britain. They attribute this mainly to two factors. First, there is a climate of opinion which regards maximum effort by *every* individual as the primary guarantee not only of material standards but of the way of life of a free society. Second, there is a quality in management, inspired by this climate of opinion, and stimulated by the American system of higher education in general and, in particular, by that part of it which is devoted to administrative studies. American business employs graduates because it believes that higher education helps business.

Earlier in this same report one finds the following:

> The reports of more than 25 British productivity teams which had been issued were almost unanimous in attributing much of the drive for higher productivity per man-year which they noted as characteristic of American business to the attitude of the executives. Further, a number of these teams traced a connection between this attitude and a combination in the U.S. of facilities for higher education and strict adherence to promotion by merit.

The profit which the many productivity teams from abroad believed they gained from their brief but intensive studies of our industrial methods should encourage us as students of this same scene. No one can expect to embrace 75 years' accumulated industrial management experience of this nation in any single course. This textbook is designed to serve as an adequate beginning. Its emphasis is on the acquiring of comprehension and understanding rather than on the accumulation of factual knowledge. The endeavor here has been to emphasize principles, with factual knowledge held at the minimum essential for understanding.

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[2] *Productivity Report: Education for Management*, Anglo-American Council on Productivity, London.

Modern industrial practice in the United States has been a long time in its development. Today it represents the progress of almost a century. It is the plan of this book to draw on that accumulated "know-how," and for that reason the text is devoted almost exclusively to the experiences and practices of existing American manufacturing businesses. To study these "cases" is to learn from experience.

1. THE FACTORY AND ITS PROCESSES

The factory is the basic element in industry, its common denominator. The handicraft arts of colonial days and the skilled craftsmen who practiced them have disappeared, capitulated to the teamwork of the executive, the scientist, the mathematician, the technician, the machine, and the machine operator. Today's production, whether it is highly standardized mass production or small-scale, intricate, special-order fabrication, is factory production.

A factory is a business establishment where raw materials are worked upon to produce useful things. Industrial processes are of varied nature. They can be classified as extractive, conditioning, analytical, or synthetic. The extractive process consists of isolating a wanted substance from foreign matter with which it is associated in its natural state. Much commercial salt (NaCl) is produced by evaporation of brine. The brine is a solution of salt in water, in which state the salt is unsatisfactory for most uses. Useful salt is produced by disassociating the salt from sea water or water from salt wells. The process of evaporating the brine by either solar or generated heat to produce salt is an extractive process.

The conditioning process is one which changes the form or nature of the material so as to make it more valuable in use. Leather production is a good example. The tanning of raw hides results in leather, a product of greater durability and usefulness than the untreated skins. Relatively little has been taken away from or added to the raw material. Essentially, the production process consists of conditioning the raw material, the hides.

Another common conditioning process is that of the foundry. Pig and scrap iron, the raw material, is melted in a special type of furnace called the "cupola." The iron in molten form is poured into molds, where it is allowed to cool and harden. The process changes the form of the iron, the shape desired being obtained through the medium of the mold. In this process, the change sought is change in form, and the process is essentially a form conditioning process.

The analytical process is quite different from both the extractive and the conditioning types of process. Its essential characteristic is subdivision of a raw material into several different products. Meat packing is such a process. The raw material is subdivided into a number of finished products, the industry being noted for its by-products, which have grown in number and diversity of character as research has developed uses for those parts of the raw material which cannot be utilized in the preparation of edible meat products.

The basic characteristic of the synthetic type of process is union of two or more raw materials to form a finished product having usefulness greater or other than that of the isolated materials. In a cement plant, limestone and clay are ground fine, mixed, heated to a high temperature, and reground. The resultant commodity is portland cement. This product is obtained by synthesis, *i.e.*, by bringing together and treating certain raw materials in proper quantities and under proper conditions.

The automobile manufacturing plant is a highly developed example of this type of processing. Scores of different raw materials are formed into component parts and subassemblies which are then accurately fitted together on assembly lines to make up that complicated mechanism we know as the automobile. This type of manufacture is commonly designated as assembly industry.

Seldom do all the operations carried on in one factory fall into merely one of the four types of process just described. Usually, the operation of a factory or the production of one product involves employing more than one type of process. Companies which make textile machinery usually separate the process into three divisions. The first of these is the production of castings in a foundry department. This is a conditioning type of process. The castings from the foundry go to the machine shops, where they are re-formed on lathes, drills, grinders, and similar machine tools. This is also essentially a form conditioning process. Finished parts from the machine shops, together with other finished parts purchased outside, are brought together in, the third step, the assembly division. Here they are fitted together, and complete machines are erected from them. This process is unlike the two conditioning processes which have preceded it. It is essentially a synthetic process. The combining of several types of process in one factory is common, but study of any factory process will show that it consists of one or more of the four basic types: extraction, conditioning, analysis, and synthesis.

2. ESSENTIALS OF PRODUCTION

Whatever the character of the factory process, production always requires certain common means. In addition to raw materials, there must be workmen to carry on the operations, tools and machines to aid the workmen, power to drive the equipment, buildings to house the operations, and managers to supervise the utilization of these facilities in carrying out the production process. The relative proportions in which these various means of production are employed in any one factory depend on the nature of the process. The operating statement of a manufacturing business, which shows the details of the costs of manufacture, reflects the extent of utilization of the various means of production.

We can now amplify our definition of a factory as being a place where the means (sometimes called "factors") of production, namely, plant and equipment, labor, and management, are utilized to convert the other factor, raw materials, into products which have greater value in use than the original raw materials.

3. THE FACTORY—SEVERAL POINTS OF VIEW

Since the beginnings of the factory system, people have been variously interested in this method of production as an aspect of civilization. Economic historians have traced the mechanization of industry and have measured its progress in terms of horsepower per employee and volume of output per employee. These students of industrial history have also been much interested in such matters as industrial integration, industrial migrations, and the trends of factory industry. Much of the fruit of their labors is available to us in the voluminous literature of economic history.

The political economist looks upon factory production from a somewhat different point of view. He is more interested in the disposition of the returns industry makes to the various contributors to the production process than he is in how the process came about. He thinks and writes in terms of such concepts as capitalism, socialism, and communism.

The political observer and doer today looks upon the factory and its operations most carefully. His chief efforts have to do with legislation and public administration. He is concerned with factory production because his constituency has told him to be. A very great portion of the voters of this country support themselves through their industrial connections as owners, managers, or workers. It is only natural, then, that the politician should interest himself in industry. It follows that as the industrial activities of the nation have increased, political interest in industry has likewise become increasingly active. The most controversial and far-reaching legislation of the past decade has been concerned with the factory process and, in one sense at least, the factory itself has become one of the most pervasive considerations in the thoughts and acts of politicians and legislators.

4. THE BUSINESSMAN'S VIEWPOINT

The businessman sees the factory in a light quite different from those just described. He regards it as an opportunity for proprietary profit and, more recently, an opportunity for tangible service to the social community. The dyed-in-the-wool industrialist has an inborn desire to make things, to do things, to make the wheels go around. To him the factory and its problems constitute a how-to-do-it challenge. He is interested in creating something, how to do it well, how to do it better. And all the time he works toward this goal, he is striving equally hard to find out how to do it more easily. The more easily a thing can be made, the less it will cost. The lower his cost, the greater his share of the market, or the greater the market itself. This means profit, and profit is the lifeblood of business as the American businessman knows business. Whatever the opinion of the historian, the economist, or the politician, potential profits are the foundation of American business. This is as true today as it was in 1950, 1925, or 1900. Most important of all, most businessmen of this country understand that the greatest profit accrues to him who renders the greatest service.

5. WHY STUDENTS OF INDUSTRIAL MANAGEMENT MUST KNOW AND BE INTERESTED IN MANY VIEWPOINTS

In approaching production problems from his own point of view, the businessman finds that he is continually running into other points of view. This is not surprising. The astonishing thing is the extent to which some of the most successful businessmen have been aware of these other viewpoints and the effort they have made to understand them. It is quite probable that the outstanding successes of the few and the modest performances of the many have been in direct proportion to the understanding which the individual executive has had of the necessity of knowing divergent viewpoints and working in terms of them. Today, more than ever before, the businessman as a problem solver continuously feels the impact of these varied interests in his doings. Some business executives have foreseen the increasing impact of other interests on their problems and have been trying to teach the management team new plays that will make competitive victory possible under the new rules of the game.

The greatest concern of the sincere student of business today should be the understanding of divergent viewpoints of the factory and its activities. It is important to learn the ways and methods of the how-to-do-it businessman. It is equally important to know and understand the other points of view which have become so influential in shaping how-to-do-it policies and methods.

This text proposes to develop a sound point of view for the business manager by analyzing factory problems and businessmen's solutions to them. Each chapter contains the experience of some actual manufacturing business, with explanations as to why the executives did what they did, why they did not do something else, or what the management should have done. These experiences are presented as the basis for generalizations to serve as guides to action to be taken in other cases. No formulas for problem solution are presented, for so far as the author knows, formulas that can be depended on do not exist. Every business problem is to some extent unique, and if the platitude "Experience is the best guide" applies anywhere, it does in business-problem solution.

Accompanying each chapter are one or more business problems that have actually been faced by the managements of the companies described. The experience of seeking solutions for these problems is probably of greater value than study of the explained cases. In seeking solutions for these problems, one does well to keep in mind the viewpoint of the modern industrial executive: production is a business carried on for profit. Profits from production will not long exceed the ability of a company to produce a better product and make it readily available in the market at a lower cost. Executive decisions are business decisions rather than technical decisions; this is true largely because of the importance of perceiving and understanding a wide variety of related viewpoints that will otherwise clash disastrously with attempts at business success.

6. SUMMARY

The factory provides us with most of the products that we consume and the services that make us comfortable. In almost equal, perhaps even greater, degree, we are dependent on it for command over these consumables and services. As a people and as individuals, we secure such of the necessities and luxuries of life as we possess through efforts either directly or indirectly expended in the service of industry. This is as true of the receiving and paying tellers in a bank and the freight truck driver as it is of the turret lathe operator, the motion- and time-study engineer, and the factory purchasing agent.

The factory is a business establishment where materials are utilized by the other elements of the production process—plant and equipment, labor, and management—in making products that have demand value. The management of the factory and its processes is a business rather than a technical problem. Many techniques are important in manufacturing, but they must be directed and coordinated by executive control if they are to contribute to profits.

The business executive is essentially a problem solver. The responsibility and authority with which he is vested make his days a succession of yes-or-no decisions. A company is offered a new machine, the installation of which would make it possible to dispense with the services of several men badly needed for work in another department. It would cost as much to do the job on the new machine as it does on the machine already in use. Someone must decide whether to buy or not to buy. An executive must say yes or no.

A company is offered a $1,000,000 order. If the order is accepted, plant capacity must be increased by 10 per cent. That will necessitate an additional long-time investment in buildings and equipment of $200,000. An executive must say yes or no.

The price of a basic raw material used by a company is lower than at any time in the preceding four years. Should the company borrow $450,000 from the banks and buy enough of this raw material to take care of the company's needs for the coming 12 months? Some executive of the company must decide yes or no and accept the responsibility for the outcome.

Five workmen go before a company's production manager and tell him that 60 per cent of the workers in the company's foundry have joined a national union. They ask that the company enter into a wage contract with them as representing *all* the workmen in the foundry. What alternatives are available to this manager? What does the law permit him to do? How will the community image of his company be affected if he complies with the request? What should the manager do?

The daily life of an industrial executive consists of a succession of problems to which he must either supply solutions or approve solutions proposed by his assistants. His success as an *executive* is dependent on his ability consistently to be right in his decisions.

The aim of the student of industrial management should be the exercise of sound judgment in problem solution. The viewpoint in seeking solution of a business-management problem is invariably profit, either immediate or long-run or preferably both. In pursuing the profit objective, the experienced executive will never ignore the other varied viewpoints on factory production or fail to anticipate the import of these in arriving at decisions.

QUESTIONS

1. Classify the following production processes. Explain for each process why you classify it as you do.
    - *a.* A paint manufacturing plant
    - *b.* Construction of an aluminium door
    - *c.* Gold mining
    - *d.* Production of frozen orange juice
    - *e.* Papermaking
    - *f.* Manufacture of baseball bats
    - *g.* Logging and lumber-mill operation
    - *h.* Manufacture of automobile tires
    - *i.* Cement making
    - *j.* Erection of a brick wall
    - *k.* Making carpets
    - *l.* Production of "hi-fi" components
    - *m.* Production of paper packing cases
    - *n.* Stamping of "stereophonic" records from prepared "masters"
2. Which of the following factors of production would you rate as being of greatest importance? Explain your decision.
    - *a.* Labor
    - *b.* Management
    - *c.* Raw materials
3. It has been said that the assurance of future capable managers for a business is a major responsibility of top business executives of the company. Do you agree? Explain.
4. What advantages would you expect the production executive who has been graduated from a school of business administration to have over the man who has "risen from the ranks" without college training? What disadvantages may the college-trained man have to overcome?
5. Read a current issue of a daily newspaper carefully, and make a list of what seem to you to be the most important industrial management problems suggested by the "news." Be prepared to explain the business significance of at least one of them.

6. Why is knowledge of or even proficiency in the practice of production techniques inadequate as a sound basis for factory management?

PROBLEM 1 GEORGIA FURNITURE COMPANY.

The Georgia Furniture Company operated 19 factories in four states. Some of these plants were located in small communities where the company was the sole or largest employer. Several were located in congested areas of large industrial centers. The Boston, Massachusetts, factory was located on Route 218, a planned industrial area. Rapid growth of the area had necessitated costly widening of the Route 218 highway. The traffic capacity of this highway still was inadequate, and during mornings and evenings, when employees of the many factories along the route were going to work and returning home, the traffic accident rate was high.

During the past two years the Georgia Furniture Company had conducted a series of safety drives in one plant after another. The program employed in these drives had been developed at the company's headquarters office, conducted under the direction and leadership of a traveling task group, and had been highly successful. In plant after plant the number of accidents had been lowered, and the severity of accidents that had occurred had been reduced.

The safety drive at the Boston factory was the seventeenth plant program. Three weeks after the drive's completion, the usual check on results was made. As had been expected, man-hours lost from plant accidents had been reduced satisfactorily. Also employee absences subsequent to the drive had gone down drastically. Analysis of the figures showed that the reduction in absences was much greater than was to be expected from the reduction in plant accidents. As this had been observed following several earlier programs, the home office instructed the traveling task group to make further investigation.

The study uncovered unexpected information. Three plants were studied. In each of these a period of substantially reduced absenteeism had followed the safety drive. It was found that much of the reduction was the result of fewer accidents in the employees' homes and from an almost complete freedom from traffic accidents in which company workers were involved. It seemed that when employees became "safety conscious" in the factory they were "accident conscious" elsewhere, at home and on the highways.

QUESTIONS

1. What use should the safety task group make of this information?
2. If you were the president of the Georgia Furniture Company and had been informed of the situation described in this case, what if any company obligations would you consider were involved? What would you do about them?

2

THE WORK OF THE MANAGER

The last question appended to the preceding chapter refers explicitly to one theme that pervades that chapter: technical knowledge alone is not adequate for successful management of a factory. This second chapter explains the nature of that lack. In so doing it will make clear the major thrust of this text, its emphasis on management decisions rather than on purely technical decisions.

1. A DEFINITION OF MANAGING AS A KIND OF WORK

Let us start by making clear our concept of the manager in contrast to the nonmanager businessman. The manager makes his contribution to the success of a business enterprise through other people. Some of these "other people" may themselves do managerial work. Many of them are not managers; instead they make their contributions directly, not through other people. The manager plans the work of those for whom he is responsible, he organizes their activities, he motivates them and integrates their activities, he audits the results in order that he may replan if necessary, reorganize, and better motivate those others for whose work he is responsible.

2. EXAMPLES OF NONMANAGERS—INDIVIDUAL CONTRIBUTORS

In the factory there are many more nonmanagers than there are managers. In addition to the machine operators, the bench workers, the assembly crews, the maintenance workers whom we normally think of as "workers" rather than managers, there is that large specialist group on the payroll which is made up of such people as time-study engineers, inspectors, statisticians, payroll clerks, production schedule clerks, production chasers, materials buyers, inventory control clerks, cost accountants, shipping clerks, job evaluation specialists, and a host of others. These are important people, essential people. Some of them, such as process engineers, product design specialists, equipment designers, are people who have had long specialized training in colleges and universities, often augmented by years of professional experience. But like the inspector and the machine operator, they are not managers. They are not responsible for the work of other people; their contribution is personal and direct.

3. EXAMPLES OF MANAGERS

The work of the quality-control manager is different. He plans and organizes inspection, determines when and at what points in the process inspection shall take place, organizes and oversees the work of a group of inspectors, recommends salary increases and promotions, oversees a clerical and perhaps a statistical work force, and trains people. He is not expected to inspect; his job is to see that others fulfill the inspection functions. The general foreman is a manager. He does not operate machines, assemble parts into subassemblies. His task is to see that these things are done—by others. The same statement applies to the work of the plant superintendent and the factory manager. They make their contribution to the profits of the business through the efforts of others, managers and nonmanagers, for whose performance they are responsible. This is the distinguishing characteristic of all managerial work.

4. MANAGERS SOMETIMES DO NONMANAGING WORK

In practice there are many people who lead dual business lives, perform dual functions: at times they are personal contributors and at other times they are managers. The sales manager may occasionally call on customers. Perhaps there are a few large important customers that the sales manager reserves for himself (house accounts, they are often called). When the sales manager calls on these accounts *to sell them,* he is not at that time performing the function of a manager. He is a salesman, and like any other salesman he is then making a direct personal contribution to the business.

An office manager may occasionally make a special investigation and prepare a special report for some executive of the company. The making of this special investigation and the preparation of a report on it constitute a direct, personal contribution to the business. When so engaged the office manager is not managing, he is not a manager; he is a personal contributor just as are any of the research personnel or clerks who report to him.

The test of a manager, then, is not his position on the organization chart, not the amount of his salary, not an ownership interest in the business. Whether or not a person in an organization is or is not a manager is dependent upon the answer to the question: Does he make his contribution directly through his own activity, or is his contribution made through the work of others for whose efforts he is responsible?

5. THE TWO KINDS OF MANAGERIAL SKILLS

You cannot manage in a vacuum. Managerial work exists only in the presence of purposeful group action. Managerial planning is work planning; managerial organizing is task organizing. A classical query, still heard frequently, is whether managerial skill or technical skill is more important when selecting an executive. This seems to imply that the fully competent manager must possess two skills: skills of managing and technological skills inherent in the processes or activities for which he is responsible. Both skills are essential to effective managerial performance; which is the more important is difficult if not impossible to generalize. The effective management of a group of research scientists in a pharmaceutical manufacturing concern probably calls for more specialized scientific knowledge and ability than does good management of a group of draftsmen who prepare the tracings from which blueprints are made. The time and intellectual capacity and development needed to acquire the technical know-how content of a manager's job is determined by the character of the operating activities for which the manager is responsible.

Unlike the technical requirement of the executive's job, the management component of managing always is the same. It is composed of four elements: planning, organizing, motivating and integrating, and auditing results for purposes of replanning, reorganizing, and further motivating.

Thus all effective managers must possess and utilize two entirely different sets of capabilities, technical skills and managerial skills. Technical requirements differ with the areas of responsibility. Managerial skills always embrace the same elements. Whether he is a section manager or the general manager of a factory, whenever a person is responsible for the productive activities of others, to be effective he must know how to plan, to organize, to motivate, and to audit.

It follows then that the possession and practice of a technical skill is not necessarily managing. A knowledge of accounting techniques and the practice of accounting skills is not in itself managing. A knowledge of engineering and skill in its practice is not managing. Knowledge of time-study methods, of quality-control techniques, of incentive-wage procedures and work in these areas is not necessarily managing. Every manager must practice two sets of skills: the technical skills peculiar to the functional area in which he works and a second distinctly different set of skills, the skills essential to securing results through the efforts of others.

6. EMPHASIS IN THIS TEXT IS ON THE NONTECHNICAL SKILLS OF MANAGING

The central thrust of this text is in the direction of the skills common to all managing. Much of the work of the student will be the solution of problems that managers face. Because of the two-part character of every manager's job, these problems will always have technical content. But technology will be kept minimal; our interest in factory industry is with managers as managers, not as technicians. This is not because planning and organizing are more important than process technology. It is simply that planning and organizing are common to all managerial work in all areas and at all levels of the factory operating structure. Planning and organizing ability is universally valuable; knowledge of patternmaking in a foundry and skill in the use of time-study methods do not have this universal value.

7. MANAGERIAL PLANNING

Managerial planning involves the determination of objectives, the development of policies, the formulation of programs of action designed to achieve predetermined objectives, the preparation or approval of detailed operating schedules and budgets, and the pronouncement of such explicit directives as may be necessary to make planning effective.

8. FORMULATING OBJECTIVES

To do an effective over-all job of planning, whether at the department level or at the top executive level, the manager must always start with a clear-cut knowledge of the objectives of his particular part of the organization. Until these objectives are definitive, known and understood by all, his planning will be hit-and-miss whether it is short range or long range, covering the activities of the company as a whole or limited to the work of the plating section in an accessories division. Likewise the existence of clear-cut known objectives is equally important to the chief safety engineer, the head of the coil winding department, the chief of the materials receiving department, the foundry foreman, and to every other individual responsible for either a line or a service activity in the plant.

Many companies have clearly defined, and often recorded, statements of over-all objectives. These may relate to or cover the company's interpretation of its relations with its customers, its workers, its stockholders, its suppliers, its competitors, its industry as a whole, the particular community in which it exists. There are other concerns such as relations with its own managers and its so-called corporate image—its relations with the public. General Electric's "Progress is our most important product" is an illustration of this latter. The same can be said of Buick's "When better automobiles are built Buick will build them" and the world-known masthead pronouncement "All the news that's fit to print." Given pervasive internal understanding and acceptance, such pronouncements can be much more than rather obvious advertising appeals designed to increase company sales.

9. OBJECTIVES AT OPERATING LEVELS

While many companies have formulated statements of over-all corporate objectives, you less frequently find the pronouncement of such objectives as an initial stage of planning filtering down into the various divisions, subdivisions, and sub-subdivisions of the business. But the president of a company cannot expect his factory superintendent to plan well, to plan effectively, to plan as he wants him to plan unless both the superintendent and the president have clear and explicit knowledge of just what the superintendent's objectives are. The more this requirement of definitive objectives is common practice throughout all levels of the organization, the better the organization will operate, function harmoniously and effectively.

10. PROGRAMMING AND SHORT-RANGE PLANNING

A clear definition of objectives makes possible the planning of action designed to accomplish these objectives. Such planning will have two components: a relatively long-range program and much more detailed shorter range schedules and plans. The long-range program consists of a strategy for reaching future goals. It serves as a guide in the preparation of detailed current plans. Short-range plans can be more explicit, more detailed as to how much and just when, because in the relatively immediate future there is much less uncertainty. Daily and weekly production schedules can be precise as to quantities; monthly, seasonal, and even annual budgets can be specific as to costs. These short-run plans can cover a wide range of considerations: materials, manpower, equipment expenditures, even management needs. If short-range plans are made within the context of longer range programs, progress will be made toward the attainment of known objectives. In management planning the sequence objectives–programs–detailed plans is essential.

11. POLICY DETERMINATION

The manager who has established clear and effective objectives for his operation is in a position to formulate policies which serve as essential guides to the unity, continuity, and effectiveness of the operation.

Policies are not rules of action; they are guidelines. The earmark of good policies is that they make it easier for the man who is affected to reach judgment decisions within the scope of his responsibility and know that, although his decision may not work out as he would wish, the direction of his action was right. A policy is not an order; it is not a directive. It provides no answer to a specific problem because the solution calls for judgment on the part of the action taker. But it does serve to guide the application of judgment and by so doing eases the burden of decision making. The purpose of policy is to assure common understanding and thereby to release the energies of the manager affected for the free exercise of judgment. As one foreman said, "Policies let you know what the score is. Sure, sometimes I'm wrong, but I'm never off the track." Without policies, modern large factory organizations could not operate.

12. USE OF DIRECTIVES

But there are situations in which the exercise of judgment on the part of subordinates is not appropriate. Legal considerations sometimes dictate explicit action and preclude the desirability of alternative decisions. In such a situation the manager is well advised to dictate just what is to be done.

Sometimes to secure synchronized initiation of several independently performed but interrelated actions it is essential that an explicit directive be issued. A nonbusiness example of this latter type is common knowledge to all of us. A football team is on the offensive. In the huddle the next play has been indicated by the back who calls the signals. This play is the result of the signal-caller's judgment. The huddle breaks and the team goes into position at the scrimmage line. Each player has a specific task to perform, and the action of each must be in split-second accord with the acts of each of the other 10 men on the team. The only way that this can happen is for the individual in command to give a starting signal. This is a directive; it tells each player explicitly when to do exactly what is expected of him. No exercise of individual judgment is desired; departure from the letter of the directive will reduce the effectiveness of the team's effort. Clearly this situation calls for the issuance of a directive. Similar timing situations are found in business. When conditions call for the use of a directive, its nature as an order must be made clear to all concerned. If anyone is permitted to inject his own judgment into the situation, the effectiveness of the directive is lost.

In many respects policy pronouncements are superior to directives as a means to good management. Nevertheless there are situations in which the use of policy will not achieve the desired results. Timing synchronization is such a situation. But in general the fewer directions that must be handed down, the better.

Directives and policies are useful tools for carrying out plans. Short-range detailed plans give effect to longer range programs. Programs are the means of reaching objectives. In this statement the time sequence is in the reverse. The manager starts his planning with the setting of objectives. His planning work is not complete until he has formulated the requisite programs, detailed plans, and policies and directives.

13. RESULTS OF THE PLANNING FUNCTION MUST BE MADE KNOWN

There is only minimum gain to be had from this planning process until the results are made known to and clearly understood by all the people affected. This includes those who will carry out the plans, those to whom the manager is responsible, and many others for whom and to whom a manager is not responsible. Thus it is correct to say that if a manager is to gain full benefit from his planning work, his objectives, programs, detailed plans, policies, and directives must be known to all concerned with or affected by his planning work.

14. ALL MANAGERS MUST PLAN

It should be noted that the planning function properly should take much of the time of the top-level manager. Comparatively, the subfunction and foremen managers are likely to find a greater portion of their time required for other elements of managing work. However, planning is important right down to the first-line foreman. And as a characteristic of managing, it is as significant at that level as at any other.

15. ORGANIZING AS A PART OF THE MANAGER'S WORK

Plans accomplish nothing unless they result in action. Planned activity must be "organized." The organizing element of managing involves a number of successive steps. These include the following:

1. Explicit delineation of the total activity to be organized.
2. Subdivision of the total task into effective operating units.
3. Preparation of clear specifications for each job created by the subdivision process.
4. Selection of people and their assignment to specific areas of responsibility.

16. DEFINING THE TOTAL JOB—THE FIRST STEP IN ORGANIZING

Too frequently the total scope of an activity to be subdivided is taken for granted. Thoughtful attention to this first step in organizing makes subsequent steps easier and avoids omission of important elements that may show up as confusion and even failure when effort is made to carry out plans.

17. SUBDIVIDING THE TOTAL TASK

Subdivision of the total task into practical operating units will involve a variety of considerations. Functional differences, technical content of the work, geographic influences, number of persons involved, frequency of problem occurrence, management philosophy, and extent to which both manager and nonmanager work is required are typical bases. Whole books have been written on this topic. New knowledge of the subject is developing. Much that once was "known" shows signs of becoming obsolete. Later we will discuss this topic at greater length. Of importance here is the fact that subdivision of the total task is one part of the manager's responsibility.

18. SPECIFYING TASKS, RESPONSIBILITIES, AND AUTHORITY

The results of task subdivision should be made explicit and known to all concerned. Job descriptions, position guides, activity charters—whatever they may be called—should be written. They should cover the scope of the work, the responsibilities of the person who will be assigned to this work, and the authorities that go with the assignment. Any authorities that are withheld should be made doubly clear. The relationship of the task to other tasks should be specified.

19. SELECTING AND ASSIGNING PERSONNEL

A major gain from detailed work specification is its help in selecting and assigning personnel. Here again we can only mention an area of great current concern, an area in which much new understanding is developing. For our purpose it is enough to point out that correct selection and assignment of people to specific tasks calls for consideration of such matters as skills, future potential, experience opportunities, personal objectives, and attitudes. A major responsibility of all managers is to assure an enterprise of capable future management. Of major importance in discharging this responsibility is thoughtful consideration of the future as well as the present in selecting people for predefined tasks.

20. MOTIVATING PEOPLE AND INTEGRATING THEIR WORK—COMMUNICATING IS A BASIC SKILL

If it is possible to say that this or that part of managerial work is of first importance, probably the choice would be the manager's responsibility for motivating the people for whom he is responsible and for integrating their efforts. This involves far more than the relatively more simple task of persuading people to "work hard." Motivating people calls for skill of at least a half-dozen types. Basic to all the others is skill in communicating. There are two faces to this coin. The need for ability to explain and to clarify, both orally and in writing, long has been recognized. Speaking and writing instruction both in and out of college long has been recognized as important for executive development. Listening, the other half of the communicating concept (and perhaps the more important one), never has received comparable attention. There probably are college courses in listening, but the author never has happened upon one. Nevertheless, probably it is easier to "speak well" than it is to listen effectively. Good listening involves at least two concerns: ability to grasp that which the speaker (or writer) intends to convey and the effect which the listener has on the speaker. The way one listens can encourage the speaker in his efforts. Or it can have the effect of shutting off all effort or desire of the speaker to communicate. Oral communication has one advantage over written communication. It includes the opportunity of opening up a two-way channel, of establishing dual flow between two participants. This can make for fulfillment of the need and desire to communicate.

21. DELEGATION, A MANAGEMENT SKILL

A related but different skill is that of effective delegation. Delegating is much more than order giving. To delegate responsibility effectively one must: inform and interpret accurately, have assurance that the responsibility is willingly accepted, make certain that all with related interests understand the fact and scope of the delegation, make clear to all that only accountability is retained. This is an achievement that calls for the development of high skill and constant practice in the exercise of that skill. The idea that delegation of responsibility requires only the issuance of an oral or written statement is a mistaken notion. The extent and scope of the delegated responsibility must be completely clear. Delegation has been accomplished only when there is assurance of understanding and willing acceptance of the responsibility by the delegatee. All those with related interests must have full and accurate knowledge of the delegation and of the retention by the delegator of only accountability for the discharge of the responsibility.

Once the responsibility has been accepted, the delegator must avoid any interference with the discharge of the conferred responsibility. Any interference by the delegator will constitute an act of withdrawal of the delegated responsibility from the delegatee, thereby relieving the latter of the responsibility. One of the manager's most important responsibilities is to teach those managers who report to him how they can be most effective as delegators. Less has been written about this task than it deserves. But it is a skill that can be analyzed, and it is possible to acquire knowledge, understanding, and proficiency in this area.

22. ENCOURAGING INNOVATION AND FOSTERING INITIATIVE TAKING

Frequently managers express a wish that their people would take initiative. There is little doubt that there is too often hesitancy on the part of subordinates to initiate action and to develop and try out innovations. The basic reasons for this is that many people have learned from past experience that in general the taking of initiative does not pay. More often than not the result is censure or at least a reaction of disapprobation. A manager may say that he wishes his people to take initiative, but too often deep down he is suspicious of new methods which are departures from what he knows to have been successful ways. One of the most difficult disciplines the promoted manager must impose upon himself is to sever himself completely from the old job he is leaving. He knows he has done the work of the old assignment well; otherwise he would not have been promoted. Silently to watch the person who succeeds him on the old job fail to place his feet squarely in the footprints he established is one of the most difficult tasks the successful manager must master. But without the freedom to make mistakes and learn from them, there is no engendering the will to innovate. And it is trite to reiterate that without innovation there will be no progress.

Modern organization itself tends to stifle initiative and innovation. Specialization at the management level is possible only when there is realization that each specialized task must be recognized as one interlocking part of the whole. Thus the basic concept of management subdivision can tend to place the heavy hand of "coordination" on the wish and the will to depart from known safe ways. It can emphasize the ease of mind that accompanies the riskless middle ground.

Organizing need not do this. Much that has been said here with respect to planning and organizing is directed toward the attainment of freedom of action at the operating levels. The insistence on clear known objectives, the preference for policy formulation at every managing level, the urge to minimize directives are all in the interest of making possible the development of initiative as a way of life throughout the organization. Skillful delegation can be an important aid.

All too frequently lack of creative climate is responsible for failure to explore or to develop and try that which is new. Fear of the impact of the outcome is the block. The stimulation of initiative is essentially a matter of removing those fears. No part of the manager's task of motivating is more critical than this.

23. INTEGRATION OF INTERESTS

Successful motivating probably must rest on a foundation of understanding of the integration of those interests on which success in business enterprise depends. We have progressed well beyond the narrow notion that managing involves the reconciliation of the interests of labor and capital. The idea that the common interests of the customer, the worker, and the shareholder must be integrated with the interests of suppliers and of the environmental public is only a further extension of this older concept. The objective is balance, balance as between all these; the responsibility is to all in terms of their common interest as an integrated whole. The responsibility for achieving this balance and its maintenance obviously is a major charge and challenge to the manager.

We commonly sense these interests as group interests. Of every bit as great, and perhaps greater, import is the fact of the universal uniqueness of the interests of each individual, no matter what his group situation may be. It is essential that the interests of each individual manager, for example, have true harmony with the interests of the other managers with whom he is associated, with the interests of the enterprise of which he is a part, his industry, his community. It is all well and good to theorize and expand these interrelationships and common interests. But good managing involves more than that. It necessitates a deliberate integration of the interests, the aims, the hopes of each individual with the aims and goals of other individuals, of the company, of the community.

Fortunately for the able manager this is not the impossibly complicated task it may seem. Inherently people have many goals in common. For example, it is said that within each of us there is an innate hope, seldom expressed, that somehow before our productive days are over we can have made some small (or great) contribution to progress that will remain when our contributing days are gone. The skeptic may remark that this is idealism and not practical business. But it can be practical; it can be made a motivating force that will go far in accomplishing a recognition and integration of common objectives. To be effective, this force must have opportunity. The business enterprise must provide the possibility for the long-range contribution. Objectives, policies, and plans must be such as to encompass this potential, and managing must provide a recognizable opportunity. Perhaps it is far easier to evolve a skill and practice of individual motivation in the interest of an integrated whole than we know or think.

One more point with respect to integration of interests as a function of managerial motivation. It is common to emphasize that the manager must discharge an obligation to his community. He must be a good citizen, he must be active in community affairs, he must serve community organizations, he must often lead in these activities. What is not so often recognized is that these are the obligations of every citizen and that the business manager has unique community obligations in addition to those common to citizenship. Leaders in the enterprise must recognize this unique obligation. They have the task of developing this understanding throughout the managerial group. It is just another facet of the motivation responsibility of managing.

24. THE ABLE MANAGER MUST TEACH

Throughout this discussion of the motivating element of managing, there have been frequent implications that effective managing is in substantial degree teaching. That the manager must be a teacher has become widely accepted. It does not follow that he can make managers. As a teacher it is the manager's function to motivate others to wish to grow and to develop themselves. The manager can stimulate the desire for personal development, and he can create an environment which will make self-development less difficult. This is one of the manager's two major contributions as a teacher. His other task is to recognize and always realize that he is going to be a teacher whether he wishes it or not. What the manager does very likely will have greater influence throughout the management group than what he says. He may never deliberately attempt to create an atmosphere in which growth will be stimulated. But always he is being watched by his associates. What he does, many of them will emulate. This can be fortunate or unfortunate. In any event the manager can never completely escape his responsibility as an influence upon those about him.

Motivating, we have pointed out, requires the development and practice of a varied set of skills. These skills and their effective use probably are of the very highest order of managing ability. They are identifiable, can be analyzed, explained, and learned. Perfection in all their varied applications seldom can be achieved by any one person. The rewards for striving for some measure of perfection are great. Not the least of these is said to be the satisfaction of seeing others develop and become better and better managers.

25. AUDITING THE RESULTS OF MANAGING[1]

The comparison of results with predetermined standards of accomplishment is one of the oldest and most common of managing activities. Despite this universal use, development of new measurement concepts and techniques has been slow. Rapid and low-cost means of data processing have recently given increased impetus to progress. The booming interest in research in business is beginning to extend into the area of measuring. Social scientists are beginning to throw new light on the possibilities of measuring. The next 5 to 10 years are expected to show a very rapid growth in this particular realm.

An important part of the auditing element is the selection and development of units and systems of measurement and comparison. This appears to be a particularly fertile opportunity for advancement. Another activity in auditing is the collecting of requisite facts. Then these data must be recorded in such fashion as to make them readily usable for meaningful analysis. Finally, the factual results of analysis must be put into form that will make them most useful for decision making in the areas of replanning, reorganizing, and motivating.

Auditing is the feed-back element in managing. Its function is to be informative. Its great opportunity is enhancement of this function by expanding its coverage and intensifying its factual penetration. To date there has been too little exercise of creative imagination in this area. Quite recently there seem to be signs of recognition of the truly great opportunities that exist in this activity. We have a right to be optimistic in this respect. All replanning and reorganizing depend upon auditing's feedback for their existence. And without this constant rework there is little to be gained from the initial planning, organizing, motivating. Modern society, particularly industrial society, is so dynamic that readjustment in all managing activities must be continuous. The managing soup must be continuously stirred as otherwise progress stops. And when progress stops, retrogression sets in.

26. THE DAILY WORK OF THE MANAGER

In the daily activity of managing the four elements, planning, organizing, motivating, and auditing, rarely are found in pure form; they are so intermixed with each other that it often requires close analysis to distinguish which is going on at the moment. But analysis always will reveal that he who is managing in a responsible manner is engaged in some one or more of the many aspects of the four common, pervasive elements of managing as a unique activity: planning and replanning, organizing and reorganizing, motivating, and auditing results.

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[1] As used here the word "auditing" includes the extension of the concept of accounting auditing to all the managerial responsibilities and work of the executive.

These constitute the common skills of managing. They are not practiced in a vacuum. In business the technological context of managing is in various functional aspects of production, marketing, finance, or in combinations of these. Managing, the securing of results through the work of others, requires the practice of skills of two distinct types: those of some specialized technology and those of unique but common essentiality.

The Skills of Managing

Planning	Organizing	Motivating	Auditing
1. Objectives	1. Definition of area activity	1. Listening	1. Development and choice of standards
2. Policies	2. Subdivision of activity	2. Explaining	2. Fact collection
3. Directives	3. Task specifications	3. Delegating	3. Fact recording
4. Programs	4. Selection of men	4. Encouraging initiative and innovation	4. Fact summaries
5. Detailed plans	5. Reorganizing	5. Integrating interests	
6. Replanning		6. Developing personnel	

The title to this text is *Introduction to Industrial Management.* The essential goal of this and the preceding chapter is to provide understanding of that title. This is important because it defines our objectives and delineates the scope of our considerations.

As an "introduction" this text proposes to provide an exposure to the characteristic operating problems of men responsible for the creation of utility wealth in a free competitive business society. There is no pretext of full treatment of these problems. Greater emphasis is placed on the development of problem-solving skills: factual analysis, integrating capacity, predictive ability. Opportunity to reason from facts through appraisal of uncertainties to substantiated value judgment is provided. The many cases and problems included serve as an introductory development of skill in decision making.

Chapter I provides a notion of the nature of modern Western industry and the factory as its pervasive instrumentality. The social significance of industry in our civilization is indicated, and its critical importance in the preservation and development of our culture is suggested.

This chapter focuses on management as the factor of production in which we will have greatest interest. It includes a definition of managing as a distinct type of activity, and it describes in considerable detail the work of managing. Little is said of problem solving as a process. All managers are problem solvers. But problem solving is not the test of managing. All businessmen, managers and nonmanagers, are problem solvers. It is the character of the problems the manager must solve, the nature of the decisions the manager must make that identify him as doing managerial work. Problem solving pervades all managing. Because of this and the functionally diverse character typical of management decisions, cases and problems are the vehicles of instruction most often used in this text.

Chapters 1 and 2 are designed to make explicit the intent of the title of this book, *An Introduction to Industrial Management*, and the objectives of the text as such.

QUESTIONS

1. As explained in this chapter what is the basic difference between the work of the manager and the nonmanager in business?
2. Which of the following activities would you classify as managing?
   a. Waitress in a Howard Johnson restaurant
   b. Owner-operator of Vogue House, a beauty parlor with 22 employees
   c. A final products inspector for the Nikon Camera Company
   d. Usher in the Colonial Theater
   e. A senior partner of Coldstream and Betts, a public accounting firm.
   f. Recording secretary to the board of directors of the Winston Manufacturing Company
   g. Band leader in the Imperial Night Club
   h. Meter reader for the Springfield Gas Company
   i. Meat cutter in a First National Stores supermarket
   j. Hostess and head waitress in the Four Winds Restaurant

k. Mechanic in the Foreign Motors Garage
l. Cashier in Thompson's Grocery Store
m. Concessionaire of the vegetable and fruit department of the Star Supermarket
n. Head bookkeeper in the Babson Ford Automobile Agency
o. Publisher of the *Lexington News*, a local weekly newspaper
p. Forelady in the Superior Laundry

3. Following is a list of decisions required of managers. Each calls for the exercise of both special-function managerial skills and skills common to all managing. For each decision to be made, indicate the special-function skill involved and the management skill or skills common to all managing.

a. Deciding whether or not to include in the forthcoming year's capital expenditure schedules a request from a department superintendent for the purchase of a special-purpose machine to replace a general-purpose machine.
b. Deciding which of four advertising agencies should be given a three-year contract for introducing a new line of products.
c. Preparing a set of shop rules governing absenteeism and tardiness of clerical workers in a large factory.
d. Preparing a statement indicating the range of penalties (the greatest and the least) to be applied for failure to follow instructions issued by a foreman.
e. Approving the next year's budgets for the operating departments of a factory.
f. Deciding whether or not to authorize payment of the usual common stock dividend for a year in which no profit has been earned.
g. Assigning jobs to workers in the planer department of a machine shop.
h. Deciding what three local foundries should be approved as sources of purchased castings.
i. Deciding which of several candidates for a new foreman position should be promoted.
j. Notifying the furnace-charging crew of the proportions of scrap and pig iron to be melted in a foundry furnace for the next day's run.
k. Selecting three men from the company's industrial engineers to prepare the machine layout for a department being set up to make the parts for a new rifle.

4. What is the difference between a management directive and a policy? Under what conditions is the use of each more appropriate?

Why is the use of policy as a management tool (as contrasted to directives) often considered to be good policy itself?

5. Why is the determination and pronouncement of management objectives essential to performance of the planning work of the manager? Who should set objectives? What use will submanagers make of top-management objectives?

6. It has been said that organizing is a process of labor specialization. Is this an accurate observation? Please explain.

7. In what respects does the text differentiate between delegating and order giving? Why is delegating different?

8. "Managing as an activity is to be found at all levels of the factory organization structure." Please be prepared to explain this statement.

9. Some factory foreman are managers, and some are not. How would you determine whether or not a foreman is or is not a manager?

10. Prepare a 1,500-word paper on the following topic: "A Definition of Managing—What It Means."

PROBLEM 2 SUN FOODS COMPANY

Over a period of four years, several executives of the Sun Foods Company of Massachusetts had attended the three months' Advanced Management Program at the Harvard Graduate School of Business Administration. Upon their return to the company, many of these executives had urged that the Sun Foods Company undertake a program designed to develop systematically the managerial capacities of company executives from the department superintendent level up to and including the company's four vice-presidents, the treasurer, and the comptroller.

The Sun Foods Company manufactured and distributed nationally a large variety of prepared foods. It was well known as a leader in the industry and was continuing to grow rapidly and extend the scope of its operation. The "executive" group which included approximately 300 people was expanding as the company grew, and difficulty was experienced in meeting company needs for capable managers. As a result of urging by several executives, a new position was created and a director of executive development was given the responsibility of "providing facilities for and making means of self-improvement available to all company administrative personnel."

One of the first steps taken by the new director was a survey of what the company's 300 executives believed would be most helpful to them. Included in this survey were questions designed to determine what these executives believed to be their important responsibilities as managers. The following is a list of replies selected at random from the materials collected by the director of executive development. They are direct quotations.

1. Help the salesmen to improve their approaches to new potential customers.
2. Keep informed of general business conditions.
3. Get my people to understand the scope and limits of their authority.
4. Judge the credit standing of all new accounts.
5. Keep my people busy.
6. Train new employees in the department.
7. Check on materials waste in the packaging department.
8. Deal with our banks.
9. Get the section heads to make decisions without coming to me.
10. Get the payroll out on time.
11. Keep the foremen accident conscious.
12. Select people who will be capable of doing a good job.
13. Preparing factory budgets.
14. Putting the heat on people without their getting sore.
15. Anticipating difficulties.
16. Checking output from the cooking lines.
17. Getting people to develop better methods.
18. Getting salesmen to turn in their reports promptly.
19. Working out the annual contract with the union.
20. Formulating policies and getting people to understand them.
21. Keeping our packages attractive.
22. Buying grain at the best prices.
23. Setting workable monthly schedules.
24. Praising people when they do a really outstanding job.
25. Making sure we keep our delivery promises.
26. Selecting the right people for new jobs and promoting the right people to job vacancies.
27. Helping people to correct their mistakes.
28. Keeping sanitary standards up.
29. Setting goals for our product lines.
30. Checking inventory levels.
31. Getting the foremen to settle worker grievances without referring them upstairs to us.
32. Analyzing district sales managers' reports.
33. Keeping up with labor law interpretations.

34. Getting people to do what they are supposed to do without nagging them.
35. Getting people to cooperate.
36. Deciding how far to go in automating some of our process operations.
37. Getting the girls in the office to report in on time in the morning and after luncheon.
38. Keeping accounts collected.
39. Planning our rate of growth.
40. Getting people to accept responsibility we delegate to them.
41. Planning our advertising.
42. Getting our department heads to put their departmental policies in writing.
43. Trying to find time to think about where we should be five years from now.
44. Seeing to it that my section heads understand any new company policies that are developed.
45. Getting enough money to keep up with our growth needs.
46. Getting salesmen to get new accounts as well as service our old ones.
47. Right now I have to decide on how much money we should be giving to all the community appeals that are made to us.
48. Finding the time to read.
49. Keeping detail and paper work within reasonable bounds.
50. Being a "good guy" one minute and "hard" the next.
51. Keeping our current ratio (ratio of current assets to current liabilities) in line.
52. Getting people to be managers—we all spend too much time putting out fires.

QUESTIONS

1. Which of the foregoing reported responsibilities would you classify as problems common to all managers; which seem to you to be problems special to particular functional departments such as sales, finance, etc.?

2. List the reported responsibilities you have characterized as common to all managers under the headings shown on page 30 of this chapter. Some of these headings may not be covered by the responsibilities reported by the Sun Company managers.

PROBLEM 3 THE WEST BROOKDALE MANUFACTURING COMPANY

Mr. L. S. Daniels, assistant to the president on special assignments at the West Brookdale Manufacturing Company, was given the task of recommending men for appointment to the position of factory manager. The new factory manager would replace the incumbent vice-president and general manager in charge of manufacturing who was to be retired.

The West Brookdale Manufacturing Company, located in New Jersey, made stamped and formed metal parts for the automobile industry. These parts were sold to Middle Western automobile producers. Although it was at a competitive disadvantage because of its location in relation to its customers and to its sources of materials supply the company had enjoyed a substantial though slow growth throughout its 22 years of existence.

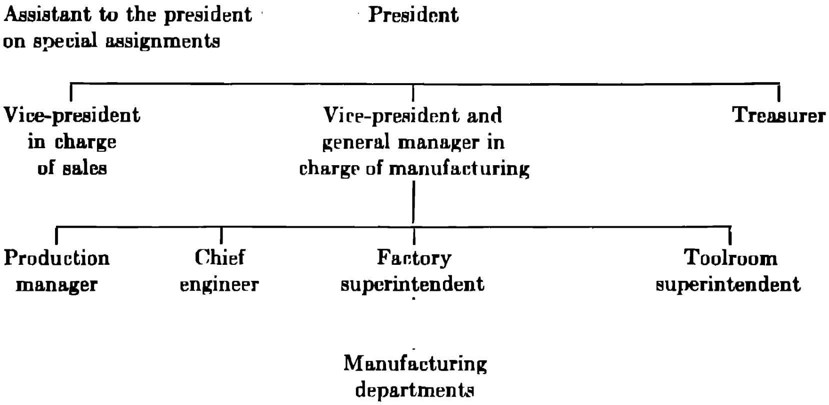
All operations were carried on in a compact three-story building. There were nine production departments, each in charge of a foreman. The company had 710 production employees, all members of the UAW, CIO-AFL union. During the Second World War there were 1,000 workers on the company's payroll. When hostilities ceased and government contracts were no longer available, employment was reduced to 400. Thereafter output was expanded slowly but steadily. It was Mr. Daniels' belief that further expansion of the work force would not be economical and that any additional growth would have to result from more effective utilization of existing facilities. The company's management organization is shown in Exhibit 1.

Mr. Daniels had held executive positions in several automobile parts manufacturing firms in the Michigan and Illinois area. Mr. Jenkins, the president and owner of 90 per cent of the stock of the West Brookdale Company, had brought Mr. Daniels to his company when he had become convinced that the company's vice-president and general manager in charge of manufacturing was no longer effective. Costs had been increasing, the plant was beset with labor troubles, promises to customers frequently were not kept, and unreliable cost estimates at times resulted in taking contracts at prices that resulted in no profit and occasionally in losses. The vice-president was sixty-eight years old and on several occasions had intimated that he would not object to retiring. When Mr. Jenkins employed Mr. Daniels he suggested the title of "assistant to the president on special assignments" and told him that his job was to "put the company back on its operating feet" again. The president told Mr. Daniels nothing about the vice-president.

Six months after he took the position with the West Brookdale Company, Mr. Daniels had a long conversation with the president. He expressed his opinion that most of the company's troubles were caused by the ineffectiveness of the vice-president. He said that at least four-fifths of the company's labor difficulties were the direct result of the vice-president's poor handling of people or of his failure to keep his word to individual workers. Poor customer relations were caused by promises made largely on "hunches." There were no machine load records, and no work standard data were available. Operations constantly were switched on orders of the vice-president without regard to any previous plans.

Exhibit 1 West Brookdale Manufacturing Company

Organization Chart (Partial)

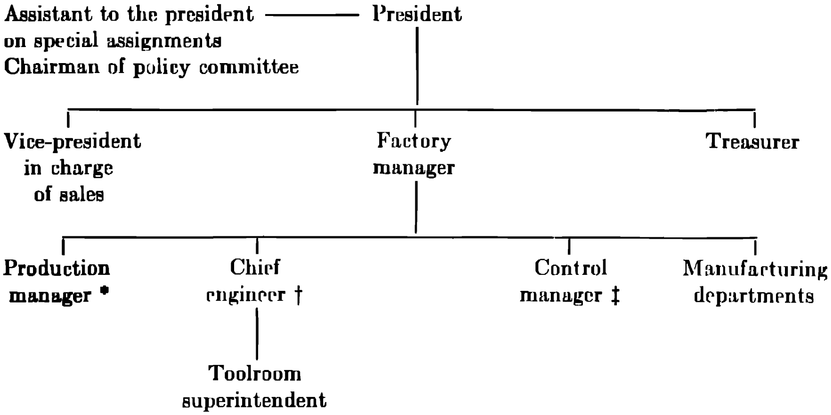

Assistant to the president on special assignments
President
Vice-president in charge of sales
Vice-president and general manager in charge of manufacturing
Treasurer
Production manager
Chief engineer
Factory superintendent
Toolroom superintendent
Manufacturing departments

The factory superintendent's idea of cost control seemed to be to turn the lights on and the water off at night. He spent no time with his foremen on such problems as elimination of unnecessary manufacturing operations. He did little or no planning for future operations. In the assembly departments, thousands of dollars of unnecessary costs were incurred because simple corrective action had not been taken in preceding departments. The vice-president was aware of these supervision deficiencies but had done nothing to improve the situation.

At the end of his conversation with the president Mr. Daniels suggested two things. He recommended that the company organization be changed to conform with that outlined in the chart shown in Exhibit 2. He urged that the vice-president be retired and that the factory superintendent (see Exhibit 1) be discharged. He had become well acquainted with all management personnel in the plant and was convinced that there was no one in the company capable of filling the job of factory manager as he envisioned the responsibilities of that position. He discussed in detail the Job Description for Factory Manager he had prepared (shown in Exhibit 3). Finally he suggested that he search for potential candidates for the position. When he had located some likely prospects, he again would meet with Mr. Jenkins.

Exhibit 2 West Brookdale Manufacturing Company

Contemplated Organization Chart (Partial)



* Responsible for planning, scheduling, and expediting.

† Functions: production methods, time study, and production standards as well as plant and equipment maintenance.

‡ Functions: purchasing, inventory control, material control.

At the conclusion of this conference the president agreed with Mr. Daniels' size-up of the situation and accepted the proposal that Mr. Daniels actively endeavor to locate a suitable factory manager. He said that once such a man was found, he would make every effort to bring him to the company. Also he would arrange the retirement of the vice-president and the factory superintendent.

Two months after the conference here described, Mr. Daniels suggested two people to Mr. Jenkins as men worth serious consideration for the new factory manager position In brief outline his opinions of these men were as follows.

Clarence Duncan was superintendent of the engine assembly section under the factory manager of a Middle Western motorcar manufacturing plant He was forty-nine years old and had 32 years of manufacturing experience behind him. He had come up the "hard" way, "through the line," having had very little formal education He had diversified experience and a first-hand knowledge of many types of automobile manufacturing operations such as assembly work, press department work, and electroplating Mr Daniels characterized him as a "production" man, full of an enormous amount of nervous energy, enthusiasm, and pep that he, in turn, attempted to instill into his men He characteristically worked long hours and seemed to forget time when in the shop He seemed very capable in getting other men to respond to his leadership Currently he was responsible for the work of about 400 men in the engine assembly and test stand department. He had 10 section foremen under him This was the "largest" job he ever had held He never had been responsible for the entire operation of a factory

The second candidate was Paul Whitcomb He was thirty-eight years old and had several years of practical manufacturing experience behind him, a few of which were in the automobile industry He had an engineering degree and had done excellent work as an industrial consultant His knowledge of standards, time study, layout, accounting, etc , was extensive Currently he was one of three partners of a small industrial consulting firm He spent much of his time advising clients on organization problems, cost reduction, and factory location and layout He was a slow-acting, deliberate, soft-spoken individual He enjoyed the confidence of his clients and was held in high esteem by them He never had been responsible for the operation of a factory but was known to have done an excellent job of handling small groups of people He was liked and respected by the operating management people in the companies which he served as consultant.

QUESTIONS

1 In your opinion are either of these men worthy of consideration by Mr Jenkins for the position of factory manager of the West Brookdale Company?

2. Judged in the light of Mr Daniels' description of the position's responsibilities (Exhibit 3), what are the relative strengths and what are the weaknesses of each man as a candidate for the position?

Exhibit 3 West Brookdale Manufacturing Company

Contemplated Job Description for Position of Factory Manager

Job Title: FACTORY MANAGER

Reports to: President

Responsible for: Divisions of Chief Engineer, Control Manager, Production Manager, and Manufacturing

Description of Responsibilities:

1. Administrates and coordinates the functions of the chief engineer, control manager, production manager, and manufacturing with those of other departments; responsible for the training, supervision, and direction of all supervision covering the functions of the chief engineer, control manager, production manager, and manufacturing.

2. Establishes general policies subject to final approval of the company's policy committee of which he is a member.

3. Gives final approval to all operating and administrative procedures affecting the manufacturing functions.

4. Responsible for the efficient operation of all manufacturing functions and the maintenance of all records and reports necessary thereto.

5. In collaboration with the president, vice-president in charge of sales, and treasurer, establishes all factory budgets.

6. Ensures and is responsible for manufacturing costs being in line with budgets previously established.

7. Originates and issues to the president or board of directors, as requested, periodic and special reports pertaining to the operations of the plant.

8. Approves all quotations for new business.

9. Collaborates with vice-president in charge of sales relative to sales forecasts, manufacturing plans, and schedules.

10. Finally approves all purchasing requisitions for capital equipment, large expenditures for repairs to buildings, or for raw materials in excess of current demand.

11. Gives final approval to all requisitions for new employees in excess of current replacement demands.

12. Gives final approval to termination of all employees.

13. Responsible for acquiring and maintaining minimum costs on all services, such as light, power, water, etc.

14. Collaborates with treasurer and personnel manager in maintaining all legal requirements affecting the plant.

15. Gives final approval to all operation routing sheets and change notices.

PROBLEM 4 THE BARNSTAPLE COMPANY

The Barnstaple Company was a family owned long-established manufacturer of diaries. Up to the time of the death of Mr. James Barnstaple, Sr., the company had been prosperous. Thereafter, under the management of the company's treasurer losses occurred. At the time of this case, Mrs. Barnstaple had just placed complete responsibility on her twenty-four-year-old son. All the information in the case was provided by this young man.

"I'm James Barnstaple, Jr. I'm the newly appointed general manager of my mother's company, the Barnstaple Company. Ten days ago—that was the seventeeth of this month, January—I called a conference of the company's production manager, the sales manager, and the treasurer. The subject of our discussion was an inventory of diaries which we manufactured last year at a cost of $50,000. Today these diaries are obsolete because of their dates, and although we still carry them on our books as a $50,000 asset, actually they are valueless.

"This company is a nationally known manufacturer of diaries. For years the business has been profitable. Three years ago my father died, and since then profits have declined steadily. Last year and the year before there were no profits; last year's loss was substantial. When Father died, Mother decided to keep on with the business. She asked Mr. Williams, the treasurer, who has been with the business for many years to assume full responsibility for operations. He agreed, and the others who worked for my father have stayed on.

"A year ago last June when I graduated from college I went right to work in the company office. I had worked in the factory and in the shipping room summers ever since my first year in high school; so I know a lot about our business, and a lot of our workers know me. I believe that during the past 18 months I have become thoroughly familiar with all aspects of our operations, our policies, and our problems. Last Christmas Mother gave me half the company's stock—she has the other half—and announced that on the first of this January I would be in full charge of the business with the title of general manager. That's how I got here.

"The line of diaries we make includes about 300 items. We sell single diaries direct to individuals by means of magazine advertising.

We supply the retail trade through jobbers, most of whom have handled our line for years. Then our salesmen sell diaries in lots of 500 or more to banks, building and loan associations, and to other similar businesses that use them for advertising purposes. Of course, most of this business is very seasonal: wholesalers want delivery by August for diaries dated the following year; banks and similar commercial buyers want delivery before January 1, usually in late November and December. Our mail order sales are spread over a much longer period. They are highest early in the year, but we do get a few mail orders as late as June of the year for which the diary is dated.

"Our college business is different. College cooperative stores and student associations buy relatively large quantities of special designs, dated from August to the next August, for distribution to purchasers of memberships at the beginning of the school year in September. These diaries usually have a certificate of membership in the association printed in them and often contain quite an amount of advertising as well. When a student joins the association, the certificate is filled out and upon payment of the membership fee the diary is given to the member without extra charge.

"Sales of individual items in our line vary from 100 or 200 to as many as 30,000 units in a year. Last year four-fifths of our sales were of 200 staple items, designs that have been in our line for several years. The remaining one-fifth was about equally divided between a group of 100 novelty styles—items that are changed frequently—and a group of 12 exclusive styles made up on special order according to designs furnished by college cooperative stores and student associations. Our novelty items differ from the standard lines in binding, size, shape, inside layout, and accessories such as locks, zipper closures, attached pencils, and the like. They are sold through jobbers along with the standard lines for the retail trade.

"We sell the college lines during the summer for September and December delivery. Each order usually specifies the number to be delivered in September and indicates the probable number wanted in December. The number to be delivered in December is subject to adjustment up or down, final determination of the exact amount being delayed until late November or early December when college executives have a better indication of probable mid-year enrollment. In the past, such adjustments have been few and almost always have been increases above the original estimates. It has been our practice to make up each of these orders complete in time for the September delivery, stocking that portion of the order which is for future delivery. If an order is made up in two lots, the second lot usually is much smaller than the first, and therefore the total unit cost of diaries made in the second lot runs from 5 to 7 per cent more than the total unit cost of diaries made in the first lot.

"When we took our year end inventory early this month we found that we had on hand diaries that we manufactured last year at a cost of $50,000. These are shown on our books and balance sheet as assets valued at what it cost us to make them. Actually they are worth nothing About half of this inventory is of novelty items with last year's dates No one is going to now buy diaries with last year's dating Last fall's college enrollments turned out to be lower than expected, and for the first time, in recent years at least, substantial portions of the college orders were canceled. Actually what has happened is that practically none of the special-order diaries which we made and stocked for spring semester delivery to college organizations have been, or will be, shipped They constitute a loss of about $25,000.

"At the conference I called 10 days ago Mr. Williams, our treasurer, presented the following figures of sales and costs of the novelty and the college lines

	College lines	Novelty lines	College lines	Novelty lines
Sales			$120,000	$130,000
Manufacturing costs				
Labor	$ 37,500	$ 62,500 *		
Materials	37,500	37,500		
Factory overhead †	50,000	25,000		
Total cost of goods manufactured	$125,000	$125,000		
Cost of inventory on hand	25,000	25,000		
Manufacturing cost of goods sold			100,000	100,000
Gross margin			$ 20,000	$ 30,000
Selling and administrative expense			25,000	30,000
Net profit or loss			$ 5,000	$ 00,000

* Novelty items were made in small lots and therefore entailed a relatively high hand labor cost

† Factory overhead consisted of such items of cost as heat, light, power, maintenance, supervision, depreciation, rent, and supplies Some of these costs varied with the rate of production, others remained relatively fixed on an annual basis irrespective of the volume of output The college lines were produced in relatively large volume which made possible utilization of the company's machines and equipment They were, therefore, assigned a larger share of the overhead than were the novelty lines

"Early in the conference someone pointed out that had the inventory carryover from last year been no greater than the usual nominal amount (in the previous year it had been less than $3,000) a satisfactory profit would have resulted. This comment started a discussion of the college and novelty lines, but we made little progress in working out a solution. After three hours all that had been accomplished was clarification of the positions of the executives present.

"The treasurer argued that both the college and novelty lines should be dropped on the basis that they were the cause of all the trouble. He said that there was no advantage in obtaining volume of output unless profit resulted therefrom. He urged that the activities of the company be somewhat curtailed. The sales manager agreed that the college lines should be discontinued, but urged that the novelty lines be retained. He pointed out that the college lines had been substantially responsible for the loss, that the gross margin on those lines was relatively small, and that they in no way contributed to the sale of the company's standard lines. The production manager objected to the retention of the novelty lines. He pointed out that while the gross margin on those lines was high, the selling expense was likewise high. He also made the statement that up to two years ago the company had made few novelty items and had experienced no difficulty in selling its standard lines. He maintained that it was no fault of the production department that the company took a loss on the college lines, and he wanted to keep them.

"Two days ago I called a second conference. We made no further progress. All that happened was that the treasurer, the production manager, and the sales manager just went over again what they had said earlier. When I saw that we were getting nowhere, I called the meeting off saying that I would think it over. Now it is clear that it is up to me. We can't afford losses such as we had this year. I'm new in the business, in a way, but I've been around here a lot for the past 10 years, and everyone knows that. I have to decide what to do, and conferences such as we have been having are of no help to me."

What would you advise young Mr. Barnstaple to do? How should he do it?

3

STANDARDIZATION

1. STANDARDIZATION, A PRINCIPLE OF MODERN MANAGEMENT

In the preceding chapter auditing the results of management's planning, organizing, and motivating activities was emphasized as essential to the successful accomplishment of these management responsibilities. The most common method the manager employs in using factual information feedback is comparison. At the planning stage, anticipated results are formulated. These serve as the goal, or standard, with which actual results are compared. The philosophy of comparison, appraising performance in the light of predetermined standards, pervades modern industrial activity at all levels of the operating organization. This is true from the first-line foreman level on up to the president. It follows, then, that the formulation of standards of many kinds is an activity common to all managers. Standardization probably can be characterized as a *principle* of modern management.

2. APPLICATIONS OF THE STANDARDIZATION PRINCIPLE

So pervasive and universal is this concept in our Western business life that we rarely give deserving thought to its ramifications and its implications. We standardize our product designs. We standardize product parts in the interest of interchangeability. We set performance standards. We accept without question the notion that we will reward those associated with a business activity to the extent that they contribute to the objectives of the enterprise. Salesmen are paid commissions; the more they sell, the more they receive. The salesman who after thorough training, guidance, supervision, and experience is unable to meet required volume standards readily recognizes the reason for his severance from the company. Many factory machine and bench workers are paid piece rates; the size of the weekly pay check is determined by the amount of acceptable work produced. Factory foremen and supervisors often receive bonuses when the operations for which they are responsible exceed "budgeted" standards. Factory managers and presidents often receive a year-end "share of the profits," the amount being determined by the amount of profit they have succeeded in obtaining. We are compensated for what we produce. If we find that we are not effective producers on a particular job, or if we see elsewhere an opportunity to produce more effectively, we unhesitatingly switch employment. This is the common "way of life" in our industrial society.

But this is not true of all industry. In Japan, for example, cultural concepts and social practices make this Western concept of the relation of the individual to the industrial institution utterly unacceptable. During his lifetime a Japanese, be he manual worker, skilled specialist, or manager, rarely works for more than one company. There is almost no freedom of movement for an individual within the industrial complex of the highly (and effectively) organized business society of the nation of the "Rising Sun."[1] Japanese managers make considerable use of standards but not in the way they are used for measurement purposes in this country. Here, they are basic to most of what we do; they are the cornerstone of our operating philosophy.

3. USE OF STANDARDS IN MEASURING RESULTS

In our management scheme, most standards are predetermined goals or performance quantifications Some are relatively simple, some are inconveniently complex. The more simple and unchanging the task, the easier it is to formulate a performance standard for it. The modern worker piece rate is based upon a precisely defined task performed in a standard prescribed manner under standard predetermined conditions that cover the work to be done, the materials to be used, the machines and tools to be employed. The worker is expected to know precisely what he is to do and how and with what he is to do it.

4. SETTING PERFORMANCE STANDARDS — FAIRFAX PREPARATIONS, INC.

For our present purposes the significant aspect of this is the process of predetermining a task standard. Most often this presupposes a restricted variety of product lines; raw materials purchased to standard specifications as to form, size, and quality; standard methods of performing work resulting from work simplification studies; inspection standards; and often standard working conditions such as temperature, light, and humidity. Following is a description of a typical experience of a company standardizing a simple factory task.

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[1] Comparison of impacts of various social structures on industry is not appropriate to the scope of this text. Anyone wishing to gain an insight into the effect of Japanese culture on Japanese business methods should read *The Japanese Factory*, James G. Abegglen, the Free Press, Glencoe, Ill., 1958.

> The industrial engineering department of Fairfax Preparations, Inc., producer of cosmetics, was making a detailed study of factory operations in an effort to reduce production costs. Each job was studied to determine in minute detail just how it should be performed, and once a satisfactory method was devised, it was reduced to writing as a basis for future performance. Prior to the setting up of standard methods of performing the work, every job study involved consideration and standardization of raw materials used, tools and appliances required, machine speeds and feeds, and working conditions. Standard methods of performance so devised had been found a very successful means of reducing costs.

5. NATURE OF A JOB TO BE STANDARDIZED

Fairfax Preparations, Inc., produced face creams, lotions, and similar cosmetics. The industrial engineering department was making a detailed study of all jobs in the plant. One of the first jobs studied was that of pasting labels on cosmetic bottles by machine.

The task was simple and required little skill. After bottles were filled and washed, they were brought by hand truck to a department in which they were labeled and packed. The operative of a labeling machine picked up a bottle from the hand truck, inserted it in the machine, and withdrew it when the label was affixed. An inspector made certain that labels were straight and in their proper position, after which bottles were packed for shipment.

6. CAUSES OF VARIATION IN METHOD OF DOING THE WORK

As a first step in the study of machine labeling, the methods engineer attempted to formulate the existing routine for doing the job. He found this impossible since the operation was rarely performed the same way twice. One cause of nonstandard routine was variation in size of the labels which were used in the same size of attaching fixture. If the label slipped in the fixture, the machine placed it on the bottle askew, and the operative had to interrupt her routine to straighten or adjust the label. This not only wasted the operative's time but caused the machine to be idle as well. Cleaning and adjusting the machine took considerable time. There was no standard way in which unlabeled bottles were brought and labeled bottles taken away. At times one truck contained the supply of unlabeled bottles and another truck received labeled bottles, although frequently one truck was used for both finished and unfinished work. Sometimes only the top shelves of trucks were used. At other times both top and lower shelves were used. Such variations made it impossible for the operative to perform her task in any uniform way. As a result, production ranged from 1,000 to 1,500 bottles a day, depending much on the number of fixture changes necessary to meet requirements of various sizes of bottles labeled and the diversity in size or design of labels.

7. EFFECT OF UNSUITABLE EQUIPMENT ON TIME REQUIRED FOR THE WORK

An investigation of equipment disclosed the fact that supply trucks were too high for the operative. This necessitated an awkward upward and lateral reach, and as the supply of bottles diminished, the lateral motion became increasingly difficult unless the operative moved the truck to a more convenient position. Moving the truck took time. Three solutions for this difficulty were suggested: a new truck could be devised, fitted with a revolving turntable so that the operator could move it easily and quickly and always have bottles in a uniform position; present trucks could be remodeled with turntables and lowered to an over-all height of 30 inches from the floor; or present trucks could be lowered without further improvements.

8. COST OF EQUIPMENT CHANGES IN RELATION TO SAVINGS TO BE EFFECTED

To determine the best solution, studies were made of workers using the high type of truck and workers using lowered experimental trucks. These studies were made by timing with a stop watch each move the operative made and recording these times in the form of a chart. The entire operation was timed repeatedly until the job-study man was satisfied that data sufficient for accuracy had been obtained. It was found that moving trucks took 2 per cent of the operative's time and that reaching upward took 11 per cent of her time, a total of 13 per cent unproductive time that might be saved if proper equipment were installed.

New trucks equipped with turntables would cost $4,000. If turntables were installed on present trucks, such reconstruction would necessitate 10 days' labor at $128 per day and materials amounting to $800, a total of $2,080. The trucks could be lowered without turntables for the relatively small cost of $192.

Total earnings of 10 labeling-machine operatives would amount to approximately $35,360 per year. Of this amount, 11 per cent, or $3,888, could be saved by expending $192 to lower the height of the present trucks. To save the additional 2 per cent, $708, which was now wasted in moving the trucks, would require an added expenditure of $1,888 on present trucks or $3,808 if new turntable trucks were purchased.

The cost of lowering the trucks would be covered by the savings resulting therefrom in approximately two weeks. It would take almost three years for the additional 2 per cent savings to cover the $1,888 cost of installing turntables, or 5½ years to cover the cost of new turntable trucks. Because of the small cost of eliminating the 11 per cent waste and the relatively large expense involved in eliminating the additional 2 per cent, the decision was made to lower the present trucks to a standard over-all height of 30 inches from the floor.

9. USE OF HELPER TO PREVENT INTERRUPTION OF OPERATIVE'S ROUTINE

The engineer recommended other changes. He urged that a table instead of a truck be used to hold labeled bottles. Inspection could be performed on this table, after which bottles could be packed from it. Substitution of the table for the truck would thus eliminate considerable handling. The engineer proposed also that a helper be provided for the labeling-machine operative. This helper could straighten slipped or twisted labels, and thus interruption of the routine of the labeling machine and its operative could be avoided.

10. TEMPORARY STANDARD METHOD OF PERFORMANCE DEVISED

In accordance with these recommendations, the inspection and packing table was installed, orders were given for the lowering of the trucks, and a helper was hired for the operative. A temporary standard method for labeling was set up (Exhibit 1). In the new standard-motion sequence, the operative used both hands as much as possible. While the left hand deposited a labeled bottle on the inspection table, the right placed an unlabeled bottle in the machine. The left hand grasped the bottle in the machine, and the right grasped a bottle on the supply truck. As the left carried the labeled bottle to the inspection table, the right carried the unlabeled one to the machine. Finally, as the left deposited the labeled bottle on the table, the right placed the unlabeled bottle in the machine. With this method there were no waste motions, and neither hand had to wait for the other.

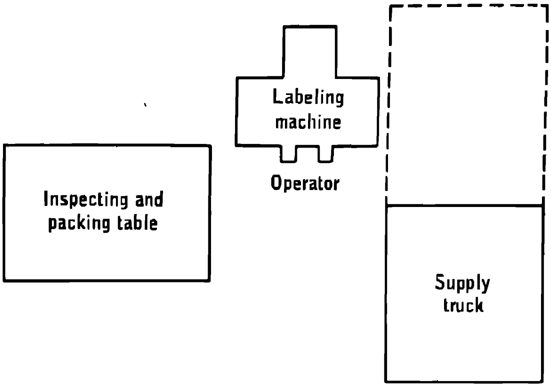

Exhibit 1. Fairfax Preparations, Inc. Temporary Standard Method of Labeling Bottles by Machine, Workplace Layout, and Motion Chart. Simultaneous Motions on Same Lines.

Left hand	Right hand
1. Release bottle on inspecting table.	1. Place unlabeled bottle in machine.
2. Go to bottle in machine and grasp it.	2. Go to supply truck and grasp bottle.
3. Carry bottle to inspecting table.	3. Carry bottle to machine.
4. Release bottle on inspecting table.	4. Place unlabeled bottle in machine.
Etc.	Etc.

11. RESULTS OBTAINED WITH THE TEMPORARY STANDARD

As the operative became accustomed to the new inspection table, to the assistance of a helper, and to the new motions, production increased from the previous 1,000 or 1,500 output to 3,000 or 3,500 for the operative and a helper. A further increase was expected when the trucks were lowered to the proposed 30-inch standard. The fluctuation between 3,000 and 3,500 was the result of variation in the number of fixture changes required. Previous to the study, the machines had labeled 32-ounce, 16-ounce, and some 8-ounce bottles. After installation of new methods, all sizes from 2-ounce to 32-ounce were labeled in each machine.

There still remained three studies to be made which the engineer regarded as prerequisite to the adoption of permanent standard methods, motions, and times.

12. STANDARDIZATION OF RAW MATERIALS AND MACHINE ADJUSTMENT

The engineer recommended that label sizes be standardized. If all labels to be used in the same fixture were uniform, the machine would place them accurately on the bottles without slipping. This would eliminate the need for a helper.

He recommended also that a motion study of fixture changing should be made. As a preliminary to this study, he devised a rack with compartments so that each fixture with its parts could be kept separate from other fixtures and parts. Previously they all had been thrown together in one box without regard to size.

13. NEED FOR BETTER PRODUCTION SCHEDULING

The engineer's third recommendation was that the scheduling of production in the filling room be studied. In the past, work in that department had consisted of a large number of small production orders. As a result, filled bottles and jars came to the labeling machines in small lots, and changing from one lot to another necessitated frequent fixture changes and readjustments of the labeling machines. It required considerable time to change fixtures, adjust the machine, and test its operation on the new lot. During that time neither the machine nor its operative was productively occupied. Usually the labels on the first bottles of a new lot were improperly attached. They then had to be straightened, and the machine had to be readjusted and tested.

If the work in the filling room was so scheduled that larger lots of one item would come to the labeling machines, fewer interruptions, changes, and adjustments would be required. The engineer believed it was possible to schedule this work so as to keep each labeling machine operating much of the time on one type and size of container with one size of label.

14. ANALYSIS OF RESULTS OF STANDARD METHOD

Pending the making of these three studies, the engineer instituted a time study of the temporary standard labeling operation in an effort to improve the motions. The following conditions obtained: the routine outlined for the temporary standard was being followed; a table was used for inspection and packing; the operative had the services of an assistant; but the lowered trucks were not as yet in use. The engineer reported as follows:

Production Analysis of Labeling by Machine

The total number of minutes actually timed was 490.21. The personal needs of the operative were:

	Minutes
Relief periods	10.00
First aid *	14.23
Lunch	60.00
Total	84.23

* The operative was underweight, and twice a day she left her machine to drink milk. Her weight soon became normal, and she no longer lost this time.

This left an actual working day of 405.98 minutes, which was divided as follows:

	Total time, minutes	Per cent working day	Number of pieces	Unit time, minutes
Operating machine productively	264.19	65.0	2,737	0.097
Operating machine nonproductively (test running)	11.06	2.7		
Changing attachments	40.98	10 1		
Cleaning machine	43.61	10.7		
Diluting glue in machine	0.81	0.2		
Adjusting machine	5.86	1.5		
Moving trucks	9.05	2.3		
Miscellaneous traveling for help, labels, trucks, rags				
Waiting for man to change attachment	26.76	6.6		
Avoidable delays	3.66	0.9		

This shows 65 per cent of the operative's working day productively occupied in using the machine, but at a unit rate of 0.097 minute per piece. The machine, however, is capable of operating at a rate of 0.035 minute per piece. Therefore, although the girl was productively occupied 65 per cent of the day, the machine was so occupied only 23.4 per cent. The difference between the two percentages (41.6 per cent) is in the handling time required, in addition to that handling time available while the machine is in the process of labeling a bottle. A change in method will reduce this extra handling time. Changes in method will also reduce those times other than "Operating machine productively."

15. SUMMARY AND CONCLUSIONS

Job Standardization Involves Many Considerations. The study just cited is typical of the experience of Fairfax Preparations, Inc., in lowering production costs by improving job methods. That the methods of the average operative are inefficient is to be expected if one considers the haphazard conditions under which he works. It is obvious that improvement of work methods can only be superficially profitable unless those factors which condition the performance of the task are controlled. To reduce any task, then, to its most simple, least wasteful, and least fatiguing series of motions involves the study of many factors: the raw materials, the surrounding conditions, the workplace itself, the machines and tools, and the changes in the nature of the work. If raw materials are standardized and always at hand when required by the operative in a standard place, position, and form; if the workplace is so designed as to be convenient for the accomplishment of the task without waste in time and physical and mental effort; if temperature, humidity, light, and noise do not distract the worker but rather recede into the background of his consciousness, leaving only a sense of opportunity for accomplishment; if the proper tools, adequately conditioned, are always at hand in their designated place just at the time they are required by the operative—then, and only then, are conditions such that the skilled observer with stop watch or motion-picture camera [2] can make an analysis of the work to be done, reduce the operation to its essential and nonessential components, and finally synthesize a standard method of performance embracing the fewest, easiest motions, combined in the simplest and most natural sequence to accomplish the task in the shortest, most efficient way.

Job Analysis Based upon Standardized Operating Conditions. When standard conditions favorable to the work have been created, the next step is analysis of the job itself and elimination of all unnecessary effort and, so far as possible, of awkward and time-consuming motions. On the basis of such studies a simple, efficient way of work can be devised and tried out. The trial period usually makes possible additional improvement, after which the method can be reduced to writing and accepted as the standard way in which the task will be performed thereafter. In putting such standards on paper it is most essential that all conditioning factors, such as tools, machine speeds, and the like, be made a part of the work standard itself.

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[2] Micromotion study has, in some instances, supplanted the stop watch in job analysis. A clock recording time in short intervals, perhaps 1/1,000 or 1/2,000 of a minute, is set in such position as to be easily read while the work is watched. Motion pictures are then taken of the operation, the rate of exposure being synchronized with the clock which appears in the picture. The developed films so made can be studied at leisure and reduced to a tabular analysis of the motions of the operative in performing the task being studied. Micromotion study differs from stop-watch study essentially in that a different tool is employed.

See Harold B. Maynard (ed.), *Industrial Engineering Handbook,* Chap. 5, p. 62, McGraw-Hill Book Company, Inc., New York, 1956.

See also Ralph M. Barnes, *Motion and Time Study,* p. 109, John Wiley & Sons, Inc., New York, 1958.

Worker Training in Standard Methods the Next Step. Determination of the best way of performing a task is the beginning rather than the end if standard work ways are to result in worker satisfaction and production economies. The essential requirement is to make sure that standard practice is followed in the production departments. This means that worker training is absolutely necessary. The methods and means of worker training are many and varied. Conditions in each shop will largely determine whether this training shall be conducted by the departmental foremen, by a training department, or under other arrangements. Regardless of how it is done, however, worker training in prescribed methods is essential if the benefits of job standardization are to be realized.

Standardization of Worker Training. The Second World War left two clearly observable impressions on operating management practice and policy in industry: (1) an intensified appreciation of the need and practicability of tighter, more exact controls of all phases of operation and (2) the need and values that come from formalized training of workers. One of the most praiseworthy accomplishments of government attempts to aid industry during the war was its Training Within Industry program. The most effective and finished product of this program was Job Instructor Training. This was a standardized procedure for teaching a worker how to do a specific task. This standardized instructional procedure was taught to thousands of foremen, supervisors, and factory training people.

The procedure was simple and effective in accomplishing its purpose. Much of its effectiveness was the result of the rigid standardization of the teaching method that was literally drilled into its practitioners. This standardization extended even to such details as to how the instructor should stand or sit, when he might put his hands in his pockets, and when he must not do so. Such a degree of strait-jacketing is commonly regarded by professional teachers as being thoroughly stifling and obnoxious. Nevertheless, it did transform thousands of totally inexperienced people into proficient instructors within a certain limited scope. The proof of that statement is the millions of workers who quickly learned to perform tasks efficiently in war factories under the standardized tutelage of "certified" J.I.T. trainers. This experience is cited here for two reasons: (1) J.I.T. taught and practiced the doctrine that worker training must be preceded by job standardization, and (2) it taught that no worker could be expected to be proficient on a job if he were allowed to select or devise his own method or methods of performing the work. Training produces no major gain except in terms of a predetermined standard job procedure. The second reason for calling attention to this wartime practice is that it illustrates the broad range of human activities to which the standardization concept is applicable in industry.

The author is a teacher. At the time of the Second World War he "took" the standardized 30-hour J.I.T. instructional program that eventuated in his becoming a "certified T.W.I. instructor trainer." He rebelled at the rigid minute requirements to which he had to conform, but he grudgingly accepted, learned, and practiced them. Today he will admit that in this matter T.W.I. was right and he was wrong. There were many occasions on which he observed certified instructors, whose total teaching experience was limited to two or three months, producing results by standard J.I.T. methods that were every bit as effective as those obtained by men who had years of successful teaching experience. True, the scope of the teaching task was greatly restricted, but within its known and accepted limitations, standardized teaching methods did as much as any one thing to enable industry to win its share of the war objective. Standardization of human activity in the factory has wide applicability, and it is recognized in American industry today as a "must" whenever a high degree of operating proficiency is desired.

Meeting Worker Opposition to New Methods. It is to be expected that a workman who has spent many years in the performance of a task will be skeptical and sometimes resentful of being required to conform to new methods. Such opposition should be anticipated. Much of it can be allayed through the employment of proper methods and tact. Intelligent application on the part of the foreman should take care of any remaining resentment. Finally, probably the most constructive method of meeting this situation is to make it worth the worker's while to learn the new method quickly and thereafter conform to it. Incentive wages in the form of bonuses and the like are most effective for such purposes.[3]

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[3] See Chap. 15.

It probably is unnecessary to point out that the use of new methods of task performance as a means of exploiting labor is bad. Such a policy distinctly tends to defeat the original purpose of job study, which is reduction in production costs by making the work easier for the operator. It is as important to avoid the appearance of any exploitation as to refrain from the practice itself.

Job Standardization the Basis for Time Standards. Just as worker instruction requires job standardization before it can produce a trained worker, so time standards must be based upon a standardized job procedure. The purposé of time study is to determine a standard time for the performance of a specific task. Obviously if the method of performing a task changes, the time required to perform the task will vary. It follows, therefore, that job time standards can be no more reliable than the consistency with which the worker follows a single work procedure. Job standardization must come first. Not until the job method has become standardized and the worker trained to proficiency in the standard method is the job truly fit for the determination of a standard time for the performance of the task. This fact is implied in the numerous union-management contracts which state specifically that the time standard on any job shall not be changed except as the nature of the job or the method of performing it is altered.

Standard Times the Basis for Production Control. Standard times for the performances of work are important in production control. They help when planning the assignment of tasks for workers, when planning machine usage, when preparing assembly schedules, when making delivery promises. All these functions must be carried out whether or not predetermined standard times for the work involved are known. When standard times are available, plans can be more precise. Also manufacturing cycle times tend to be shorter when production schedules are based on standard job times. Another gain is increased ability to keep delivery promises.

Business Aspects of Job Standardization. In view of the savings in labor cost that result from job study and the utilization of standard methods, one wonders that the practice has not had more universal acceptance. The reason is probably lack of understanding of the business aspects of the situation on the part of plant executives and job-study technicians alike. Job study and task standardization too often have been regarded as highly technical, costly procedures suited only to large establishments and applicable exclusively to situations where repetitious tasks on large volumes exist. As job study has been carried on in the past, these limitations have probably been controlling factors.

More recently it has been realized that job study in the interest of motion economy need not involve complicated techniques and that economical use of standard methods of task performance is possible even when the task is performed intermittently and when the volume of any one run is not great. Much can be done in improving ways of work without using either the stop watch or the micromotion camera. If foreman and workers are taught to be motion-economy-minded, improvement in ways of doing jobs will become a matter of everyday occurrence. In the bottle labeling operation just described, it required no time study to observe that the label's slipping, which necessitated the operative's straightening the label on the bottle, was cutting down the output of the labeling machines. Nor was time study essential in determining the solution. No stop watch was required to see that idleness of both machine and operative resulted from the frequent waits during fixture change. Even the need for lowering the trucks would have been obvious to either a foreman or a worker who had been taught the advantages of standardized access to raw materials and the economy of certain types of arm and body movements as compared with motions having more awkward and tiring characteristics.

It is common practice in benchwork for the worker to hold parts or assemblies in the left hand while practically all actual work is performed with the right hand. Strange as it may seem, in such cases it is the left hand that tires. In four out of five such cases the worker's output can be increased greatly through the devising of a simple, inexpensive fixture for holding the work, thereby releasing the worker's left hand from fatiguing nonproductive effort. Opportunities for such improvement in ways of working are many and become quickly apparent to the observer who is looking for them. They involve no complicated technique, entail no great costs, and arouse no opposition when intelligently carried out and understood by the workers.

In such a program of task improvement by means of motion economy, the worker's attitude and interest always must be considered. It is not difficult to get the essential worker cooperation in such a program, provided that the worker understands the objectives and is given an incentive to take part. In really successful programs of this type, workers have been found the most prolific of all sources of suggestion of improvement. The worker is closer to the job than anyone else, knows what elements of the task are most tiring, where wastes and waits most frequently occur. A large part of the effort in such an endeavor should be directed toward training workers to understand opportunities for task improvement and to recognize the types of work ways which are bad and those which are good.

When work methods which have been improved are employed only occasionally because of noncontinuous performance of the task, they can be retained by means of simple written instructions preserved for future use. Such instructions will show clearly how the workplace should be arranged, what fixtures and tools should be used, and the easiest way of performing the task. When workers become accustomed to the use of such instruction cards, it is possible to employ standard task methods even on jobs which occur infrequently.[4]

Task improvement and standardization, when carried out along this line, are sound from the business standpoint. The costs of such improvements can be low and the returns great. That maximum savings are not attained from such "nonscientific" methods should be of no great concern. Maximum returns can be had only by the more technical procedures such as the stop watch and micromotion camera. These intensive studies are much more costly, and all too frequently the added economies do not warrant the added costs. When large volumes of work are involved, the total savings mount and the more costly procedures become profitable. The easily discovered and easily remedied errors are the ones which yield greatest returns per dollar expended for improvement. Additional intensive studies will yield less and less returns, and the costs will be greater. These greater costs, however, will be fully justified if the total volume of the task is sufficient to allow the smaller economies to accumulate into large savings.

Job study and standardization can be profitably practiced in their elemental form in almost any business. This simple, common-sense approach will often yield surprising results per dollar of effort invested. This is not to belittle the more elaborate techniques of the time-study and motion-study engineer. From a business standpoint each has its place and usefulness in industrial management.

Importance of Quality Standards. Little has been said in this case about standards applied to quality of output.[5] Obviously, little is accomplished by setting up standard methods of operation which do not result in output of satisfactory quality. It is equally obvious that the word "satisfactory" implies quality measurement. Measurement is only possible in terms of some predetermined standard. An unfortunate practice in attempting quality control is to consider the experience of a foreman or an inspector as a sufficient standard by which to judge current output. It is much better practice to define quality requirements meticulously and to put such requirements systematically into writing. Inspection requirements thus set become true standards. The common use of tolerances in machining operations is an excellent example of such standards. All use of gauges in production is based upon the definition and acceptance of standards.

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[4] The recent use of teaching machines on production jobs and lines is a somewhat more sophisticated method of obtaining the advantages of standard methods when jobs are not performed continuously.

[5] For discussion of quality control, see Chap. 21.

Standardization, a Fundamental Concept in Management Control. Successful management is dependent on wide application of the measurement and feedback concepts of auditing. The most common method of using audit data is comparison of actual results with predetermined standards. At the top of the modern business organization standards take the form of budgets: operating budgets, cash budgets, sales budgets, manpower budgets, and others. These are preplanned standards to be used for purposes of comparison. These over-all standards will be most useful when they are supported by similar standards of a more detailed nature. At the base of this pyramid of factory operating standards is the simple task or job standard. The experience and procedure in the Fairfax Preparations, Inc., company is typical: study to produce a simple and easy standard method of performing the task, analysis to determine a standard time expectancy for performing the task.

As has been pointed out, simple work improvement in itself is profitable. However, it is only when the improvement takes the form of a standard way of doing the job which then is taught the worker that it becomes possible to develop a standard accomplishment time. And for effective management control, the existence of a standard performance time is essential. Time standards on jobs serve several purposes. Among them two are outstanding. They make possible more reliable planning of future operations, thereby contributing to the usefulness of budgets; they are themselves a base for auditing, for measuring and judging results at the operating levels.

Throughout world industry we here in the United States are looked upon as leaders in management effectiveness. Standardization (in all its varied applications) is recognized as a basic concept in our management know-how. Current studies of managing around the globe—in Germany, Italy, Turkey, Hong Kong, the Philippines, Taiwan, Japan—bear testimony to wide overseas efforts to adopt or adapt the standardization practiced by industrial management in the United States. Successful foreign applications are only too evident in the competition we are experiencing from these overseas producers. We have not exhausted the usefulness of standardization as an effective managing device. There still is much that we can learn about it, and even more that we can do in utilizing broadly what we know and learn.

QUESTIONS

1. What was the objective of the first step undertaken by the methods engineer in the study of machine labeling at the Fairfax company?
2. What were the results of this first part of his study?
3. What were the relative advantages and disadvantages of
   a. Purchase of new trucks
   b. Lowering the existing trucks
   c. Equipping the existing trucks with turntables
4. Do you consider the engineer's recommendation with respect to the trucks sound? Why?
5. What was gained by the development of a temporary standard method of labeling?
6. What caused the increased output from the labeling machines?
7. In the interest of increasing labeling output still more, the engineer made additional recommendations. What were these and why was each made?
8. Be prepared to explain any relationships that may exist between any of the following: job time standards, worker training, annual departmental manpower budgets, standard job methods, machine output standards, delivery promises, worker and foreman evaluation.
9. Usually workers are paid weekly either in proportion to the work they turn out or the hours they work. This seldom is true of the machines the worker uses. Why then would the management be concerned about the fact that although the operative was productively occupied 65 per cent of the workday, the labeling machine was productively occupied only 23.4 per cent of the workday?
10. Write a paper on one of the following topics:
    a. Standardization, a Basic Principle of Modern Management.
    b. Top Management Should Concern Itself with Task Standards at the Worker Level.
    c. How Much Should Management Spend on Job Study and Standardization?
    d. How the Business Manager Uses the Principle of Comparison in Measuring Results of What He Does.

PROBLEM 5 WHITE METAL PRODUCTS COMPANY

The manufacturing-equipment committee of the White Metal Products Company was asked to approve a budget request of the padlock division for the purchase of a special milling machine equipped with a rotary driving unit and four drum fixtures. This equipment was requested in order to reduce labor costs of the division. According to the request, which had been prepared by the superintendent of the padlock division, purchase of the machine and the specified fixtures would make possible, in a period of four years, savings in direct labor expense equal to the total required investment. The committee discovered in conversations with the superintendent that, if more drum fixtures were purchased or if the division standardized certain product parts which might be milled on the machine, additional savings in direct labor expense would be made.

The management of the White Metal Products Company used annual budgets for a variety of operating purposes. Each year, division heads submitted requests for new equipment to the company's manufacturing-equipment committee which approved or rejected them for inclusion in the next year's budget. These requests were accompanied by reports on results which were being obtained from equipment purchased the preceding year.

Although the company's funds for purchases of new equipment were considered ample, the committee believed that the company should not risk large investments in experiments. On all requests for equipment, the committee questioned members of the division making the requisition. The committee operated on the basis of a policy that it would not consider any request for equipment unless the division could show that under expected conditions the savings in direct labor cost which would be made possible by the purchase of the equipment would equal the required investment within four years. Equipment sometimes was purchased for improving the quality of a product even though no direct labor saving resulted.

The requisition for the milling machine stated that the machine was needed to reduce the cost of cutting the "nose" and "heel" of padlock shackles. A shackle is the U-shaped round metal piece of a padlock which is inserted through a chain, staple, or whatever device is to be held by the lock. Cutting the nose of a shackle consists of forming the notch on the inside of one arm of the shackle. When the padlock is locked, a plunger is inserted in this notch and the shackle is clamped firmly to the body of the lock. When the padlock is unlocked, the plunger becomes disengaged and allows the nose of the lock to be completely released. For shackles used in medium-priced and high-priced locks, a heel, the flat portion of the other arm of the shackle, also is formed. The plunger built into locks of these price classes presses against the flat side when the lock is unlocked and the nose of the shackle is disengaged. This plunger prevents the shackle from being snapped into the locked position except when the nose of the shackle is directly in line with the body of the lock and can be inserted into the nose hole of the lock.

At the time the machine was requisitioned in order to reduce the cost of forming the nose and heel on padlock shackles, the two operations were being performed on milling equipment which required a large amount of work on the part of the operative. The operative's work consisted of (1) placing the shackle in a fixture, (2) inserting the fixture with the shackle in the mill and seeing that the shackle remained in position during the milling operation, (3) withdrawing the fixture from the mill, and (4) removing the shackle from the fixture. Two shackles were milled simultaneously with this equipment, but the nose and heel of a shackle could not be milled at the same time. Hence, when the operative milled shackles for locks of the better grades, which were heeled as well as nosed, he handled the shackles twice. Exhibit 1 shows the total wages paid during one year for milling shackles by this method.

The semiautomatic milling machine, which the padlock division wished to purchase for milling the heel and nose of shackles, would require little manual work on the part of the operative. With this machine, the operative would have only to drop a shackle into the slot of a drum attached to a revolving fixture. Machining and removal of the shackle would be automatic. Although heels and noses of shackles would have to be milled separately, the machine was so simple to operate that the company manufacturing it guaranteed an output of 2,700 cuts, or 1,350 shackles an hour. This figure allowed for the fact that shackles which had both a nose and a heel would have to be handled twice. The company stated that a trained operative could easily obtain an output of 2,000 nosed and heeled shackles an hour. The superintendent of the padlock division estimated that operatives of his division could secure an average output of 1,800 nosed and heeled shackles an hour with the machine and that the piece rate for milling these shackles could be lowered to $0.002 per shackle.

The number of diameters of shackles used by the padlock division was large; it had grown gradually over a period of years. All shackles were manufactured from bar-stock steel of standard sizes by another division of the company which finished them ready for assembly except for cutting the nose and heel. The superintendent of the padlock division stated that many of these diameters could be discontinued and other diameters used in their place without affecting the completeness of the company's padlock line.

Exhibit 1 White Metal Products Company

Number of Shackles Milled in One Year According to Size of Shackle

Diameter of shackle, inches	Number of shackles	Direct wages paid for milling
0.150	2,820	$ 9.00
0.160	1,524	4.56
0.178	10,012	90.12
0.195	11,124	108.00
0.228	119,532	999.28
0.236	840	6.32
0.242	183,864	1,885.72
0.265	14,868	157.56
0.278	19,848	165.92
0.292	6,708	56.68
0.317	15,840	102.92
0.330	252	4.88
0.349	59,724	378.12
0.362	348	5.52
0.371	3,948	39.72
0.410	1,332	22.68
0.415	0	0.00
0.456	852	15.72
0.521	48	0.84

In fact, he believed the division could well standardize on four diameters of shackles. If this policy was adopted, however, the base of each style of lock which had used one of the discontinued shackle diameters would have to be redesigned to accommodate a shackle of different size. This change would require the purchase of a new die for making the body of each style of lock that would use a new size of shackle. On the average, each diameter of shackle then carried by the company was being used in three different styles of locks and the die for each style cost $1,600.

The superintendent of the padlock division, who prepared the requisition that was submitted to the committee, did not suggest that the company standardize at once on four sizes of shackles; he proposed only to use the machine to mill shackles of the following four diameters:

Diameter, inches	Number machined in one year	Total wages paid for machining
0.228	119,532	$ 995.28
0.242	183,864	1,885.72
0.317	15,840	102.92
0.349	59,724	378.12
	378,960	$3,366.04

Four drums costing $500 each would be required in addition to the cost of the machine, which would be $7,800. If the piece rate for the above four diameters of shackles was lowered to $0.002 per shackle, yearly labor cost, on the basis of the current output, for machining shackles of these diameters would be $757.92. Compared with the actual labor cost of machining shackles of these four diameters during the past year, a saving of $2,608.12 a year would be made. On this basis the machine would pay for itself in four years. Under this proposal, existing equipment would be used for milling shackles of other diameters.

If additional drums were purchased, a larger number of shackles could be milled on the machine and greater direct-labor savings could be made. These additional drums might be worthless, however, if the division later standardized on four diameters of shackles.

All savings in production cost, however small, were considered of great importance. Competition in the sale of padlocks had become extremely keen. In the sale of small locks using a shackle of 0.242-inch diameter or less, competition was largely on a price basis. The superintendent of the padlock division stated that locks of this type were sold by certain manufacturers at prices which he believed sufficient only to cover labor and materials. The manager of the sales department had told the superintendent that it was necessary to continue making locks of this type if the company was to secure adequate distribution of its products. The manager believed that dealers would not carry the company's locks unless the company offered a complete line.

What action should the equipment committee of the White Metal Products Company take?

PROBLEM 6 ONTARIO FIDELITY LABORATORIES, LTD. (B)

The management of Ontario Fidelity Laboratories, Ltd., had decided to add a medium-quality radio and record-player loudspeaker to its line of quality electronic sound-reproducing equipment. Several alternative methods of producing the initial lot of these speakers were available. The production manager of the company had to decide which method should be adopted.

The Ontario Fidelity Laboratories, Ltd., of Ontario, Canada, made high-quality frequency-modulation and amplitude-modulation radio tuners, fine radio and record-player amplifiers, and high-quality speakers. To complete this line, the company made and sold a record turntable and pickup of superior quality. Interest in quality electronic equipment for home use had become so great that Ontario Fidelity Laboratories, Ltd., had designed and sold a second line of tuners and amplifiers of good quality but somewhat lower price. During the past year, sales volume of this second line was four times the volume of its higher-priced line. The management of Ontario Fidelity Laboratories, Ltd., believed that the volume of the second line was likely to continue its rapid growth and was destined to become the major part of the company's business.

The management wished to complete its lower-priced line by making a suitable speaker and a lower-priced turntable and pickup. Company engineers had developed a design for a less-expensive speaker, the handmade models of which gave excellent results. Whether or not this design would prove entirely satisfactory could be determined only after a considerable number had been sold and used by customers. The management believed its design good enough to warrant manufacture for the coming year.

The management estimated that if the speaker was satisfactory 5,000 of them would be sold the first year. They realized that some modifications of the existing design might be advantageous competitively during the year, and decided, therefore, to make speaker parts in lots of 100 at a time.

Three ways of making the initial lot of 100 spiders were considered:

1. They could be cut from sheet steel by hand and then welded.
2. Blanks could be stamped out on a press and then finished by hand.
3. They could be made complete on presses by adding a drawing die and operation to follow the blanking operation.

To make the 100 spiders by hand would take 100 hours of labor at a cost of $2.10 per hour.

If a blanking die was used, the die would cost $104. The blanking press would stamp out 50 pieces per hour and the labor cost of operating the press would be $1.90 an hour. There would be an additional labor cost for finishing the 100 spiders which was estimated to require 50 hours of work at $2.10 an hour.

The third possibility was to use a drawing die in place of hand finishing the blanks stamped out by the blanking die. This die would cost an additional $240 but would eliminate all hand finishing. The labor cost of operating the press for the finishing operation would be $3.80 for a lot of 100 spiders.

Both the blanking die and the finishing die would have a physical life of 100,000 pieces. Any spider design changes that would be made during the coming year would have no effect on the blanking die, as these changes could be taken care of during the hand-finishing operation that followed the blanking. If a finishing die was purchased, any design change probably would necessitate either changing the finishing die or scrapping it. The cost of changing the die would depend upon the character of the design change.

At the time the management was considering which of the three foregoing methods should be used to produce the initial lot of 100 spiders for the new lower-priced speaker, one of the company's product design engineers pointed out that if the design of the new speaker was changed slightly the spider currently used in the company's higher-priced speaker could be used for the proposed speaker. This spider was more rigid than had been specified for the new speaker and, therefore, less subject to vibration. Its design was the result of three years of development and testing in the market and was expected to require no design modifications for the next two years. At the end of that time the engineers expected to have developed a radically changed high-performance speaker which would require an entirely new spider design.

During the preceding two years the company had produced and sold 4,500 of these high-priced speakers. The sales department estimated that 5,500 would be sold during the next two years.

Both blanking and finishing dies were used in producing the spider for the higher-priced speaker. These dies had cost $500. When purchased they had an anticipated physical life of 100,000 pieces. When the speaker for which they had been purchased would be redesigned, these dies would be of no further use to the company. The labor cost of producing these spiders was known to be $7.50 per lot of 100 spiders.

If the spider that had been designed for the proposed lower-priced speaker proved to be as successful as was expected, the sales department estimated that the company would sell 25,000 to 30,000 of them before substantial changes in design would be required.

The design engineer who had suggested using the same spider for both speakers urged that this be done. He cited the case of an automobile manufacturer that recently had added a V-6 engine (six cylinders arranged in a V) to the line of V-8 engines with which its automobiles had been equipped. The new engine had been designed to use many of the parts that were being produced for the V-8 motors. These interchangeable parts were said to include the valves and valve lifters, rocker arms with their supporting brackets and associated smaller parts, the fuel pump, the oil pump, bearings and bearing caps for the crankshaft, much of the electrical equipment, the water-pump assembly complete, and scores of other parts, large and small. One result of this parts standardization was that new tooling would be required only for parts that were not interchangeable between the V-8 and the V-6 motors. Standard interchangeable parts for the new V-6 would be obtained simply by increasing production schedules for the V-8. This engineer pointed out that the concept of parts standardization for several product models was becoming increasingly employed in many industrial lines. He stated his belief that Ontario Laboratories could make substantial savings if its products were designed with this standardization in mind.

How should the initial lot of 100 spiders for the new speaker be made?

PROBLEM 7 KOLSTER AND JENKINS TOOL COMPANY

Executives of the Kolster and Jenkins Tool Company had been asked to change the method of paying employees in the sheet-metal department of its newly acquired subsidiary, the Waterford Company. Sheet-metal department workers had been paid hourly wages. The union requested that they be paid piece rates.

The Kolster and Jenkins Tool Company manufactured small metal-working power tools. Its product line consisted of drill presses, engine lathes, shapers, and milling machines in various sizes. On several occasions the company executives had considered adding a line of small power tools for professional and "do-it-yourself" woodworkers. When it was learned that the owner-managers of the Waterford Company wished to retire from active business life, the president of the Kolster and Jenkins company arranged an exchange of capital stock of the two companies that gave the "K and J" company ownership control of the Waterford Company.

The Waterford Company manufactured drill presses, circular table saws, band saws, jig saws, shapers, sanders, and jointers for woodworking. These were produced in two grades: a "professional" line which it sold to cabinet and furniture shops, and a lower-priced "utility" line which it sold to hobbyists. For several years sales of the latter line had grown steadily until its sales volume equaled 20 times the volume of the higher-priced line. This growth seemed likely to continue.

For years Waterford had manufactured all the metal parts going into its products except electric motors, screws and other fasteners, and sheet-metal parts. Tool guides, gauges, guards, containers, and many lightweight bases and frames for the utility line were fabricated from sheet iron and steel. These parts had been purchased from two suppliers, ready for assembly with the exception of a small amount of drilling.

A year before the K and J company acquired Waterford, the latter had added a sheet-metal shop for the production of stamped and drawn parts for both its product lines. The growth of the utility line had made this desirable. The new shop was fully equipped with modern facilities for blanking, bending, stamping, drawing, drilling, grinding, welding, brazing, plating, and polishing all the sheet-metal parts used by the company. When K and J bought Waterford, the sheet-metal shop was in full operation. It employed 38 workmen, a planning and scheduling man, an assistant foreman, and a foreman. Waterford no longer purchased sheet-metal parts.

The Waterford plant consisted of four departments: machine shop, sheet-metal shop, assembly shop, and shipping room. All workers in the machine shop belonged to a local union affiliated with a national one. During the year of the sheet-metal shop's existence, workers in that shop had joined the machine-shop workers' union, and the plant thereby became fully unionized.

All production planning and control in the machine and assembly shops was based on standard operating times. These standards originally had been set by an outside consulting firm employed by Waterford management for that purpose. It had taken the consultants two years to determine standard job procedures and to make time studies that resulted in standard operating times for the 5,000 operations performed in the machine and assembly shops. The company had paid the consulting firm over $290,000 for its services.

During the two years the consultants were working in the plant, Waterford management had built up its own standards department. This department was manned by 22 technicians, industrial engineers whose function it was to set standards on new tasks and revise standards on jobs that changed because of improvements in product design. They analyzed jobs to develop simple easy methods of doing the work. They prepared standard operation methods sheets that described the standard work methods in detail. These operation sheets were used by foremen to instruct workers in proper job performance. After workers became proficient in the standard methods, the methods department engineers used stop watches to set a standard time for performing each task. These standard times included allowances to cover work interruptions, workers' personal needs, end of the day fatigue, etc. These standard times were used as the basis of all work scheduling and machine loading in the assembly and machine shop.

The use of these standards had resulted in very substantial gains. They had shortened the manufacturing cycle time—the time required to produce a finished product. They had increased machine output enormously, an average of 61 per cent. Delivery times were shortened, and failures to keep delivery promises which once had been very troublesome had almost disappeared. Worker output increased an average of 40 per cent, and although direct labor costs had been reduced substantially workers' earnings had increased an average of

31 per cent. During the process of setting job standards, a variety of inefficiencies were discovered: poor organization of tool stocks in the toolroom, excessive materials inventories, frequent shortages of certain raw materials, excessive handling and delayed transfer of parts in process between operations, inefficient inspection—sometimes inadequate, sometimes excessive. These discoveries led to remedial measures, and management was highly pleased with the results—they believed that they had achieved a "controlled shop."

These improvements involved considerable costs: salaries of the 22 men in the standards department, increased timekeeping and payroll make-up costs, some increase in other indirect labor costs in the stockroom and for first-line supervision. But over all management was pleased, workers were pleased, and the union was pleased, for customers were better served, costs were down, and worker take-home pay was up.

Shortly after the Kolster and Jenkins company acquired Waterford, the union requested K and J to pay incentive wages to workers in the sheet-metal department. Waterford workers in the machine shop and assembly department were paid piece rates. The rates had been set following the establishment of time standards for jobs in these departments. The piece rates had been set by negotiations between union representatives and Waterford personnel department executives. It was the change from hourly rates to piece rates that had enabled machine shop and assembly workers to increase their earnings.

When the sheet-metal shop was established, the union had asked that workers in the new department be paid piece rates. Waterford management had rejected this request. They pointed out that the department was newly organized, that all the equipment was new and unfamiliar to Waterford supervision, that all the workers in the department were newly employed, and that in their judgment hourly rates were more suitable to the situation. Thus when K and J took over Waterford all workers in the sheet-metal department were paid on an hourly basis. Their take-home pay averaged about 40 per cent less than that of workers in the other two departments.

In their own plants the Kolster and Jenkins company never had paid incentive wages. Their workers were not unionized, and all were paid hourly rates. The level of wages of K and J workers was about 20 per cent below that of workers in the Waterford plant.

The request of the Waterford union was discussed at some length by K and J executives. There was considerable objection to granting the request on the basis that it might result in a similar request from workers in the K and J production departments. After considerable discussion, it was decided to have the standards engineers at Waterford investigate the feasibility and costs of putting the Waterford sheet-metal department on piece rates.

Following a four weeks' study of the sheet-metal department, Waterford methods engineers submitted a report to K and J executives from which the following information was abstracted.

A. To achieve maximum operating economy in the department an eight months' methods and time study will be necessary.

B. Concerted cooperation of the department foreman with the job standards team would be essential. This man is unfamiliar with methods standardization, has never used standard times for planning and scheduling, and has never supervised workers who were paid incentive wages. However, he voiced no opposition to the proposed program and seemed likely to cooperate.

C. The study would cover the usual improvements in work methods such as the positioning of load and unload tables at each machine, study of two-man versus the existing one-man operation of the shear to attain higher machine output and increase in worker efficiency, appraisal of bottleneck operations, machine locations, and floor-space requirements for effective working conditions. Special studies such as the following would be required:

1. Development and use of templates and template storage racks to reduce layout and setup time.
2. Study and probably reduction of the amount of gauging presently being required.
3. Analysis of the accuracy of the gauges with which punches and presses are equipped to reduce layout time and scrap.
4. Develop weld specifications to reduce and standardize the amount of work required.

D. The investigation of the department was made in several steps.

1. Average actual times currently required for the performance of 12 of the most common jobs were determined.
2. An approximation was made of the probable time that would be taken by workers on these jobs if they followed present work methods and were paid piece rates based on these methods and present hourly rates.
3. Improved methods were devised for performing the 12 jobs, and workers were instructed in these methods.
4. After the workers had become proficient in the new methods, detailed stop-watch studies were made of each job and standard times—including all allowances for personal needs, interruptions of the work, and fatigue—were set for the 12 jobs.
5. Comparison of the standard time thus set on the new methods with the actual time taken when the old methods were used showed a reduction in time required of 38.8 per cent.

6. Comparison of standard times set by stop-watch studies of the new method with estimated times if workers used the old methods and were paid piece rates based on them showed variations ranging from plus 11 per cent to minus 13 per cent.

7. Payroll savings were calculated:

Annual departmental payroll	$98,106
Savings in time at 38.8 per cent	38,065
Less lost time from imperfect operation	9,810
Net payroll savings	$28,255

8. Cost of installation:

Two-time study men, 8 months	$ 9,600
Time-study supervision (⅓ man)	2,400
Services of an outside consultant (1 day per month plus expenses)	1,600
Cost of making methods changes (no new machines included)	4,800
Total costs of installation	$18,400

It was proposed that the installation be made by two engineers from Waterford's standards department. These men would spend full time for eight months making the installation. Two new men would be added to the Waterford standards department. One of these eventually would be retained to maintain standards in the sheet-metal department; the other would be retained on the basis of the turnover of engineers usually experienced in the standards department. No additional supervisory help would be needed in the standards department either during the installation or afterward. The supervision cost item in the installation calculation represented an allocation of current costs of time-study supervision to the new activity. It was proposed to bring in each month a consultant who was familiar with setting standards for press and sheet-metal work to advise the two company engineers assigned to the installation. These two men were not experienced in setting standards on sheet-metal operations.

9. Annual cost of maintaining standards:

One time-study engineer	$ 7,800
Time-study supervision (by the standards department supervisor)	1,200
Indirect costs:	
Payroll tabulation	1,860
Timekeeping cost increase	5,800
Quality-control supervision	1,250
Total annual cost of maintaining standards	$17,910

QUESTIONS

1. What did the management of the Waterford Company mean by the statement that they had achieved a "controlled" shop?
2. Please be prepared to discuss the procedure employed by the Waterford standards department in its study of the sheet-metal department.
3. What would you advise the executives of the Kolster and Jenkins Tool Company to do about the union request?

4
LARGE-SCALE MASS PRODUCTION

STANDARD AUTO SERVICE CORPORATION

1. A TYPICAL EXAMPLE OF MASS PRODUCTION METHODS—LABOR SPECIALIZATION

This chapter deals with specialization, a practice found throughout industry in the United States. The Standard Auto Service Corporation is a company that has applied the specialization concept profitably. Much of the chapter is about this company: its methods, its problems, and its successes. The company was selected for discussion because of the skill with which its management has employed the specialization concept.

2. UNITED STATES INDUSTRY AS THE WORLD SEES IT

Today, in all the world, there is no more highly industrialized nation than the United States. Our friends and our opponents agree on this. Our industrialization is characterized as being of "advanced" character, as being "scientifically managed." Above all else it is "mass production." This element of size is what most impresses the world. Both the aggregate of our industrial output and the large size of many of our producing units are common foci of overseas admiration, wishful thinking, criticism, or attack.

There are other highly industrialized countries, but the form is different. Japan is an excellent example. Throughout the world Japan is known for its industrial aggressiveness. What is less known is that 90 per cent of the 405,526 industrial firms in Japan have less than 20 employees. Only $\frac{3}{10}$ of 1 per cent (0.3 per cent) employ 300 people or more.[1] Japan is an industrialized nation, but there is relatively little mass production there.

With substantial variations in degree, the same condition exists in other industrialized countries. The Canadian manufacturer regrets the restricted size of his market which "makes mass production impossible." Large-scale manufacturing is found in France, in Germany, in the United Kingdom. But one hope of the proponents of the European Common Market is that by increasing the scope of the free marketing area the scale of factory production can rise to a more competitive level. Large-scale mass production is held in great esteem by industry world-wide. The United States is considered to be the outstanding example of the importance of size for industrial success.

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[1] Boye De Mente, *Japanese Manners and Ethics in Business*, pp. 106 and 107, East Asia Publishing Company, Ltd., Tokyo, 1960.

3. OUR FAITH IN MASS PRODUCTION CONCEPTS

While it may well be said that the economy of mass production is but one of many economic beliefs of our time, in American industry of the twentieth century it is difficult to discover a goal, an aim, a practice, or a policy that is not directly a part of, or supplementary to, belief in the basic advantage of large-scale output.

A study of modern industrial management must, then, concern itself with an investigation of the validity of this belief, as well as the causes and effects of its general acceptance.

4. NATURE AND DEVELOPMENT OF MASS PRODUCTION

Mass production, as we find it today, is based upon the extensive application of certain industrial concepts which have been utilized from the beginnings of the industrial revolution, a period commonly characterized as embracing the general application of power in the productive process, division of labor, and transfer of skill. Basically, modern practice adds little to this list. Division of labor has become intensified as "labor specialization." The application of the principle of specialization has been extended beyond the field of labor. Process specialization, product specialization, plant specialization, equipment specialization, management specialization (organization), all of which are common problems of modern operation, are but extensions in application of the thesis of Adam Smith[2] and Charles Babbage.[3] The concepts are the same, though the terms, the environment, and the problems resulting therefrom have changed in their implications and significance.

Essentially, mass production embraces problems of specialization, of standardization, of diversification, and of integration. Our examination of large-scale or mass production must extend to all these. Specialization offers an advantageous point of attack.

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[2] Adam Smith, *Wealth of Nations*, 1776.

[3] Charles Babbage, *Economy of Manufactures*, 1832.

5. DEPENDENCE ON MARKET SIZE

Early in this chapter it was pointed out that access to an extensive market is believed to be essential for the full application of large-scale production techniques such as specialization. The absolute size requirement varies with the nature of the product produced. The automobile manufacturer (an outstanding employer of mass production specialization) needs an available market that includes millions of buyers. The modern mechanized automobile-washing establishment is equally dependent upon an adequate market. But in this case the size of market, the number of potential patrons required, is but a very small fraction of the market essential to the automobile manufacturer. Nonetheless, the availability of an *adequate* market is every bit as critical for a large-scale automobile-washing establishment as it is for the automobile manufacturer.

6. THE STANDARD AUTO SERVICE CORPORATION'S MARKETS

Much of the success of the Standard Auto Service Corporation is the result of careful attention to this concept. This company has been in the business of rendering high-speed automobile washing for many years; it opened its first "super-service" station over 20 years ago. At this unit complete lubrication, tire, gasoline, and battery service was offered. Brake testing and adjustment and automobile washing were features new to service stations at that time.

The company's first station was located carefully for the convenience of local, commuter, and tourist traffic on a main traffic artery and near a high-class apartment district. Company managers believed that the relatively high leasing costs resulting from selection of such a valuable site was justified in view of the large volume of business potentially obtainable in the location.

The station was attractively designed and was arranged to service the motorist's needs rapidly and in a pleasant manner. The operating personnel of the station were carefully trained both in the technique of duties and in such matters as courtesy and information service to customers. The attendants were distinctively uniformed, and the station was a model of cleanliness. All this attention to detail resulted in attracting permanent customers and also increasing the average sale to customers.

The car-washing service offered at this station was unique in the community at that time. The management had been attracted by the large-scale "auto laundries" which had recently made their appearance in some of the larger cities. Company executives believed that the speed and efficiency with which these systems operated would prove attractive to customers, and the relatively large output of which such systems were capable indicated possibilities of sizable profits. The addition of car washing practically completed the service offered to customers. In the past, few service stations had engaged in this activity because of the large space required and the relatively high labor cost involved. Modern automobile laundries had neither of these disadvantages, and as there was no such washing system in the city when the new station was established, company executives had believed that the inclusion of large-scale automobile washing was desirable.

7. HAND METHOD OF AUTOMOBILE WASHING DESCRIBED

When the usual methods of car washing were employed, the customer drove his car into the garage, received a claim check for it, and was told that his automobile would be ready for him in two to six hours. Much washing was done at night. The washing process was usually performed by a crew of two men, but sometimes one man carried out the entire operation.

The first step, after the car was placed on the wash rack, was to remove all articles from the interior and then to brush out all dirt from the cushions. The floor mats were next removed and cleaned. This done, the washer flushed the car for several minutes with a stream of clear water from a hose. This softened the dirt and grime and made its removal easier. The washer then took a bucket of warm soapsuds and sponged the entire car, with the exception of the parts where there might be grease. Those parts received the same treatment, but another sponge was used in order to prevent the transfer of grease to the body, hood, and such surfaces. After the car was completely washed by hand with soap and water, it was rinsed with a hose and wiped off with a clean sponge to make sure that all soap had been removed. At this time, special attention was paid to the windshield and windows, both inside and out.

If the washing crew consisted of two men, the car was then turned over to the second one. This man first removed all stains and surplus water with a clean chamois. This done, he polished the body, hood, and fenders with soft cloths. Windows and exterior and interior metalwork then received his attention. When the entire automobile was polished to his satisfaction, the interior trim and cushions were cleaned with a special type of vacuum cleaner, and the floor mats were vacuumed and adjusted in the car. Any articles which had been removed from the car were replaced, and the car was ready for the customer.

The entire process required 1½ to 2 hours when one man worked alone. When two men worked as a crew, the time could frequently be reduced to 1 hour.

B. LARGE-SCALE AUTOMOBILE WASHING

In the modern car-laundry method, the automobile went through practically the same process. However, by replacing the two-man crew with a force of 34 to 40 men and girls, each specializing on a certain operation or part of an operation, the application of the principle of specialization of labor and use of specialized equipment made it possible to reduce the total time required for washing a car to 13 minutes. The process required a building of special design with equip-

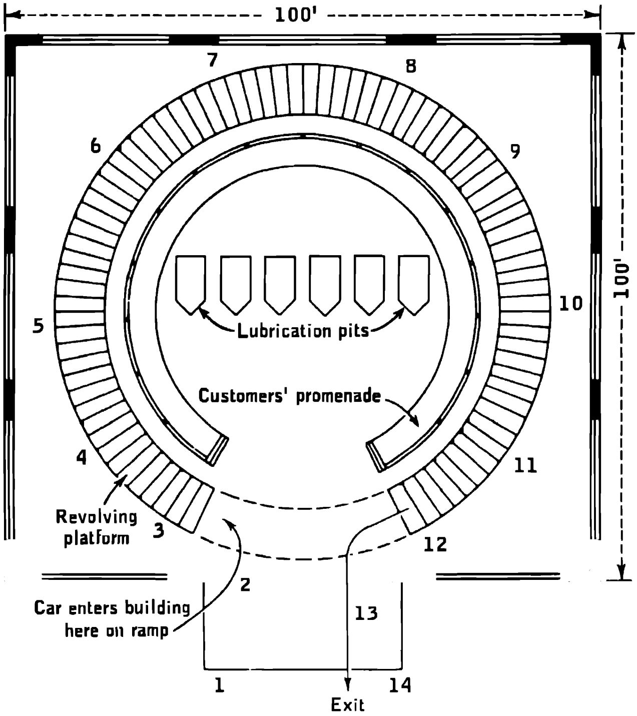

Exhibit 1. Standard Auto Service Corporation. Diagram to Show Layout of Large-scale Washing System.

ment to correspond. The Standard Auto Service Company's plant, 100 by 100 feet, had an output capacity of one car a minute. The diagram, Exhibit 1 on page 78, shows the layout of the system.

A car to be washed was driven up the entrance ramp and onto a moving circular platform at the left. This track was propelled by an electric driving mechanism so adjusted that the platform made a complete revolution in 13 minutes. The various workers were stationed at different points about the track so that upon the completion of a revolution the car had passed through the entire process and, cleaned and polished inside and out, was ready to be delivered to the customer. The track had a capacity of 13 cars. Thus, when it was operated at its maximum capacity, cars were washed at the rate of one a minute. The metal track, or platform, was floored with heavy wooden planking so spaced as to allow the water to drain through into a sluiceway beneath the track. An abundance of light was provided by large windows which occupied the maximum wall space available. There were also large skylights in the roof.

Inside the moving platform on which the cars were washed was a glass-protected promenade which proved a great attraction to the customer, who could follow the progress of his car through the complete washing operation. Elaborate waiting rooms were located in a separate building. These rooms were equipped with such features as radio and automatic phonograph. Attractive accessory and tire displays, together with effective printed matter, were used to bring the various services of the station to the customer's attention.

9. LABOR SPECIALIZATION IN AUTOMOBILE WASHING

The washing process itself was essentially the same as that used when two-man crews were employed. Its chief difference was in the specialization of the workers. Instead of one or two men doing the complete washing job, a large crew was employed. Each worker had a specific task to perform. Each task constituted one step in the washing process, and the cooperative efforts of the entire crew were required to complete the washing and polishing.

A car to be washed was driven by company employees to the entrance ramp, where loose articles within the car were removed and placed in a locker provided for that purpose. There was a separate locker for each car, and a locker identification tag was attached to the car when the contents were removed to the locker. Two men spent their entire time at this task, which is located in the foregoing diagram by the numeral 1.

As soon as the car had been emptied, it was driven by another employee up the ramp and onto the moving platform. One man specialized on this task. Job 3 was carried on by one man who used compressed air to blow dust from the seats and floor of the car interior. The automatically rotating platform carried the car on to job 4. At that point an overhead sprinkler flushed the entire car with water to loosen grime and dirt. The valve which controlled this sprinkler was operated by a man on a raised platform. This worker also washed the car top with a long-handled brush and then removed excess water from the top with another brush.

At point 5 the chassis and underside of the fenders were thoroughly washed. Four men worked on this job, two on each side of the track. Each man was equipped with a hose which threw a heated emulsion of oil and water at high pressure. The temperature of the mixture was 135 degrees Fahrenheit, and the pressure used was 400 pounds.

At the next point, 6 on the diagram, four men sponged the entire car, using warm soapsuds. After that, the car moved on to operation 7, which consisted of a thorough rinsing. Two men performed this task, using hoses and clear water. At point 8 on the track, two men used compressed air to blow all surplus water from the car surfaces.

10. COORDINATION—AN ESSENTIAL OF SUCCESSFUL LABOR SPECIALIZATION

The following operation, number 9, was performed by a group of four girls who, with chamois and cloths, wiped and polished the entire car, inside and out. Operation 10 was an exact duplication of operation 9. This repetition was necessary because otherwise a bottleneck[4] would develop at that point. One four-girl crew could not completely wipe and polish the car in the time available. It was not practical to use more than four girls on the task at one time for they would seriously interfere with each other's work. Thus, it was necessary to do one of two things, either slow down the speed of the revolving track or repeat the operation. Slowing down the track to enable one group of four girls to wipe and polish satisfactorily would cut the rate of

[4] When the flow of product through a process is held up at some point in the process because of slowness of the operation at that point, a bottleneck is said to exist. Bottlenecks are best prevented by careful coordination of all operations in the process in terms of the time required for each. This necessitates proper breakup of the process into component parts or operations and proper manning of each individual operation to secure such coordination. A continuous process can never be more rapid than its slowest element.

output of the plant approximately one-half. It was, therefore, desirable to repeat the operation. By this means, maximum speed was attained and a bottleneck was avoided.

From the second polishing operation, cars progressed to the eleventh station on the line, where two men equipped with specially designed vacuum cleaners thoroughly vacuumed the interior, after which the cars were ready for inspection. Two men, at point 12 on the diagram, inspected each car, rectified any minor defects in the job, and O.K.'d cars for release to customers.

11. IMPORTANCE OF INSPECTION

In this large-scale car-washing operation inspection was a most important function. It was imperative from the standpoint of assuring the customer of a quality job. In a process so highly subdivided, no one individual was responsible for the quality of the work. A first-class washing job was dependent on each worker's doing his allotted task thoroughly and well. Quality was thus dependent on the efforts of all rather than on desire to excel or pride in workmanship of one individual. Getting each worker to do his or her best was a problem. Inspection thus became important for the protection of the company's reputation for quality and in order to maintain individual effort through fixing individual responsibility for any lack of thoroughness.

After the car had been inspected, it was driven from the wash rack. One man could do this work and just keep up with the output of the wash rack when it was being operated at capacity. This man turned the car over to the last group of workers, 14 on the diagram, which consisted of two men who replaced all articles previously removed from the car.

12. NECESSITY FOR REPLACEMENT WORKERS

In addition to the 32 men and girls required on the washing rack, 4 to 6 workers were required to maintain and operate the mechanical equipment and to reclaim supplies such as rags and oils. These workers were trained to take the place of workers along the revolving platform in case such workers were temporarily absent or left their jobs. Such trained replacements were important, for while it took a much shorter time for a worker to learn one of the specialized jobs than it would to become an expert all-round washer, it was much more essential that every specialized worker be an expert at his or her individual task. The speed of the entire process could be no greater than the speed of the slowest employee, and therefore a reserve supply of experienced workers was essential to effective operation of the entire system.

13. MECHANICAL PACING OF WORKERS

Another characteristic of the process which made expert workers necessary was the lack of opportunity for "warming up." Unless deliberately controlled in the matter, a worker when beginning a job normally requires a certain period of time in which to reach top working speed and efficiency. With the mechanically operated track, the speed of work was automatically set, and the worker in keeping up with the mechanical conveyor was forced to acquire top speed at the start and to maintain it. This had the advantage of eliminating the inefficient worker as well as cutting to a minimum periods of submaximum productivity for the good worker. On the other hand, it definitely limited the occasional superior worker whose ability would have enabled him to effect greater output were it not that he could not speed up beyond the rate of the group as regulated by the machine.

14. IMPORTANCE OF UNIFORM RAW MATERIALS

The managers of Standard Auto Service Corporation were attracted by their new method of washing largely because of the speed with which a car could be washed and the relatively low cost of doing the job. Both of these features were, in the main, the result of two things: the breaking down of the process of washing a car into a number of simple, standard parts and the extensive use of mechanical equipment. The nature of the process was such as to make this breaking down effective. The job to be done was a fairly standard one. True, cars varied as to the amount and character of dirt on them. There were large cars and small cars, closed and open ones. White side-wall tires were popular. Wheels were occasionally of wire. These variations were not so great, however, as to make breaking down the process difficult. For all practical purposes the "material" (the cars) was similar and the process uniform.

Moreover, by varying the number of workers assigned to the task, it was possible to break down car washing into tasks which could be accomplished in the same length of time. One man could drive cars into the building in the same time as was required for four men to sponge the body and two men to vacuum the interior.

15. USE OF MECHANICAL EQUIPMENT

In substantial degree the subdivision of the washing process made economical the extensive use of mechanical equipment. When automobile washing is done by a crew of one or two men, the equipment provided is usually limited to the bare necessities, such as sponges, polishing cloths, soap solution, water supply, and provision for disposal of the water used. Greater investment in mechanical devices is not economical, principally because of inability to use them intensively. When one man completely washes a car, only one part of the process is being carried on at one time, and only such equipment as is helpful in that part is in use. Any equipment provided for other parts of the process is idle. When the work is subdivided and all parts of the process are carried on simultaneously, all the mechanical equipment provided for the complete process is in constant use. Investment in mechanical equipment is profitable only in proportion as the equipment is used in the production process; idle equipment pays no dividends. Thus, the subdivision of the car-washing process and its accompanying specialization of labor, by creating a situation which makes for intensity of utilization of equipment, fosters the use of mechanical devices. The two outstanding characteristics of the large-scale method of car washing, breakdown of the process into a number of simple, standard parts and the extensive use of mechanical equipment, are closely interrelated. Specialization makes the use of mechanical devices economical; the extensive use of mechanical equipment intensifies the advantages of labor specialization.

16. RESULTS OF LABOR SPECIALIZATION

The ability to break down the process into simple, standard parts made possible labor specialization and lower labor costs. Extensive use of the most efficient mechanical devices reduced the total amount of labor expended in the washing of a car. Specialization and simplification of the work eliminated time lost in changing from one part of the process to another, since each worker was confined to but one step in the process. Repetition of the simple task made the worker extremely efficient on the job and tended to eliminate all unnecessary movements, thus reducing physical fatigue. First-class, experienced car washers were not easy to obtain. By subdividing the process, such experts were made unnecessary. Inexperienced workers could be trained to the simple tasks relatively quickly, and maximum performance on the job was ensured by the mechanical conveyor. Expert washers commanded relatively high wages; this was not true of the type of worker required when the tasks were subdivided. All these advantages made for a relatively low labor cost per car washed.

17. EFFECTS OF MASS PRODUCTION ON PLANT AND EQUIPMENT OPERATING COSTS

In addition to the labor cost advantage, several other desirable results were obtained. A much smaller building was required for a 600-car output per day with the system than would have been the case if two-man crews with individual wash racks were employed. This made for a greater washing output per square foot of floor space, with a consequent reduction of operating cost. Costs thus affected included plant maintenance, interest on investment, ground rent, depreciation on building and equipment, and the like.

The relatively short time required to wash a car under the new system tended to reduce these same costs.

18. EFFECT ON QUALITY OF OUTPUT

The use of a standard washing process with highly specialized workers using the best of equipment should result in a washing job of excellent quality. This would be true, however, only if careful, regularized inspection was maintained. At the new station provision was made for such a safeguard, and work of a uniformly high quality resulted.

19. EFFECT ON SALES VOLUME AND PRICE

The speed of the process was one of its most important characteristics. It caused steady customers at the service station to have their cars washed more frequently. A 15-minute wait was the most that was required of the motorist, who could spend that time pleasantly either on the promenade watching the progress of his car or in the well-appointed waiting rooms. The short waiting period made it possible to direct the customer's attention to other services of the company and offered opportunity for displaying an attractive line of accessories.

A charge of $1.25 was made for car washing. This was $0.75 to $1.25 lower than the prices charged by other car-washing establishments in the city.

20. RISKS OF A SPECIALIZED INVESTMENT

The total cost of the service station including land, buildings, equipment, and fixtures was approximately $200,000. Of this amount, $102,690 was the cost of building and equipping a car-washing plant with a maximum capacity of 600 cars for each 10 hours of operation. The large initial investment had required a location such that volume could be built up rapidly to a point approximating the capacity of the washing plant. During the early months when business was being developed, the costs of operation per car washed were relatively great. Depreciation, property taxes, interest charges, and plant maintenance were constant, with little change due to fluctuation in volume of business. So far as these items were concerned, it cost no more to wash 600 cars in a 10-hour day than it did to wash 60 in an equal period of time. Thus, the nearer to capacity the plant was operated, the lower the cost of these items per car washed.

21. IMPORTANCE OF VOLUME

The use of a high degree of labor specialization likewise tended to make operating costs inflexible. It was necessary to have practically the same crew on the wash rack to turn out 20 cars per hour as it was to turn out 60 per hour. Thus, again, operation at a figure approaching capacity was important.

Because of the relative importance of getting volume of business at the new station, company executives had chosen the higher priced of two locations available at the time. The less costly location might possibly have yielded as high a volume as the other. However, the location with the higher rental was such as to ensure volume more certainly, and the risks incident to large initial investment and heavy developmental operation losses warranted the selection of the more costly of the two locations.

22. UNIFORM VOLUME DESIRABLE

The more expensive location had one other advantage. It was larger, and space was available for parking 75 cars. This was important since, in some degree, it relieved a serious weakness in the situation. In addition to the necessity for a large volume of business to make the wash rack pay, it was desirable that the rate at which cars came to the station to be washed be as nearly uniform as possible. It was obvious that business would be slack at certain hours of the day and that some days would be busier than others. Weather conditions affected the amount of washing available. A certain amount of storage space had proved valuable in smoothing out hourly peaks, since some customers were glad to leave their cars to be washed and return for them in an hour or two. Parking space made it possible to store up a certain amount of the rush-hour business for building up the dull hours of the day.

23. MINIMUM VOLUME REQUIREMENT TO COVER COSTS OF OPERATION

The Standard Auto Service Corporation's first service station was successful. At an average daily output of 200 cars, the income from the plant exactly paid all costs of operation: labor, supplies and other burden costs, including such items as supervision, office workers' salaries, interest on borrowed money, taxes, depreciation, power, heat, light, water, and repairs. On volume in excess of this 200-car daily average, profits on capital invested by the proprietors were realized. Washing jobs substantially in excess of an average of 200 per day were obtained. Profits on the high initial investment were satisfactory, and the company grew to be a state-wide operation.

24. PROBLEMS OF GROWTH

As service stations were added, it became increasingly difficult to find suitable locations. In many localities no site that would assure the needed volume of car washing could be found. As a result the number of company stations not offering car-washing service soon exceeded the number of stations where car washing was included.

Recently the company has opened up two car-washing establishments where no other services are offered. Company executives have learned that the location requirements of profitable car washing are different from those of the usual service station. The two newest car-washing stations are on relatively low-cost sites on the outskirts of city suburbs. One of these suburbs contains a large number of apartment houses; the other does not. Both sites are on heavily traveled routes leading through suburban settlements into the city.

25. USE OF LOWER-COST PLANTS

The plant and equipment of the two newest plants cost much less than any of the older car-washing units. Waiting rooms are adequate and comfortable, but not elaborate. There is no provision for car owners to watch the washing process.

26. USE OF LESS COSTLY EQUIPMENT

The layout of the washing line is simpler. The mechanical equipment is less costly although it performs some operations done by hand at older installations. Examples are tire-wall washing and top washing. The revolving platform of older installations (Exhibit 1) has been replaced by a straight-line endless chain to which cars are attached and which then pulls the cars through the sequence of washing operations. The first step in the washing sequence is tire-wall washing. The car automatically trips a control which causes live steam and a detergent to be sprayed under a high pressure onto the tires. At the same time a series of revolving brushes scrubs the tire walls. This has eliminated hand washing of whitewall tires completely.

A large revolving brush located horizontally above the cars lowers automatically and eliminates hand washing of car tops. At the same time large rotating brushes set vertically wash the two sides of the car as it passes between them. Hand washing is thus reduced greatly. The number of hand washers is varied to conform to the volume of work at any time.

27. HOW FLEXIBILITY IN RELATION TO VOLUME FLUCTUATIONS IS ATTAINED

The speed of the conveyor cannot be varied. At times when the volume of business is low, prior to 10 o'clock in the morning on Mondays through Fridays for example, only a small number of workers are on the line. During periods of high business pressure on Saturdays and on Sunday morning, the number of workers is increased. This variation runs from a low of 12 men, the minimum number required to operate the installation, to 48, the the maximum number that can work effectively in the space available. On stormy days the installation is shut down completely. The company subscribes to a local-forecasting service which it has found useful in deciding when to close and open the operation. For an additional sum of 10 cents, a customer can buy rain insurance. If it rains during the 24 hours after the customer's car is washed, he gets an additional car wash without charge.

The washing speed of the new installations is somewhat greater than the old. This results from the increased use of mechanical devices. The volume of business, hour by hour and day by day, varies more than in the older installations. Because of this, the variation of crew size is very important. During the Saturday and Sunday peaks and the high rate weekday periods, 4:00 P.M. to 6:00 P.M., the additional work force is recruited from local high-school boys. To secure adequate workers who will accept variation in the amount of work available to them, it is necessary to pay hourly rates that are relatively high for unskilled workers. A core crew of 12 steady workers reports daily and is assured of steady work of 40 hours weekly. When they work more than 40 hours in a week, they receive overtime. No girls are employed. Twice as many supervisors are on hand during peak hours as are needed in the older installations. The changing size of the work crew with its accompanying shifts in job assignments has made this necessary to assure output and high quality.

28. RESULTS IN NEW-TYPE LOCATIONS

The washing plant in the suburb containing the large number of apartment houses has been in operation for 16 months and clearly will be a financial success. Its fixed costs are relatively low, and although wage rates are high it has proved possible to keep labor costs down by varying the size of the work crew. The other suburban installation has been in operation (at the time this is written) only four months. The population density of this area is substantially lower than that in which the other suburban plant is located. There is evidence, however, that residents in this area have their cars washed more frequently than do apartment dwellers. The relative profitability of this site still is unproved. If this operation proves to be profitable, it will increase the expansion potentials for the company greatly.

29. RESULTS FROM LABOR SPECIALIZATION

The experience of the Standard Auto Service Corporation is an excellent illustration of the application of the economic principle of labor specialization and its relation to mass production. It portrays many of the business considerations inherent in the utilization of the concept in profit-making endeavors.

Labor specialization was possible in this case because of the nature of the process and the character of product worked upon. These facilitated subdivision of the complete process into simple, standard operations which could be rapidly and satisfactorily performed by relatively unskilled, available labor.

Breakdown of the process into simple components made possible the extensive use of mechanical aids. This result often follows labor specialization and makes it easier to devise inexpensive mechanical equipment. The simpler the function, the less complicated, and therefore the less costly, will be the mechanical requirements of devices designed to carry out or facilitate the operation.

The tendency to mechanize specialized tasks is furthered by a business consideration, the intensification of use of such equipment when the process is highly subdivided. Idle equipment is the bane of the industrial executive. Idle equipment earns no return on the money invested in it. Often it depreciates or becomes obsolescent as rapidly when idle as when in use. Costs of maintenance are sometimes no greater for equipment in operation than for idle machines and tools. The tendency toward constant use which is characteristic of equipment employed by specialized labor often results in the installation and use of mechanical aids the existence of which is made technically practical by the simplification of the tasks performed by specialized workers.

Standard Auto Service Corporation executives found labor specialization to result in lower labor cost for each car washed. Labor was more efficient as a result of frequent repetition of the task and elimination of nonproductive effort. Worker idleness was reduced by the pacing effect of the power-driven conveyors. Increased use of mechanical devices made workers' tasks easier, eliminated many of them. Less skilled, more readily available workers were used, and wage rates tended to be lower.

These low unit labor costs were offset in some degree by high plant and equipment costs. Low total cost per car washed resulted only when high plant costs were exceeded by labor cost savings. In the two newest installations the lower fixed costs of plant and equipment have been definite gains. Low total unit costs are obtained only if the plant is operated at a relatively high rate. The nearer this rate approaches capacity, the lower the cost of washing each car and the greater the profit from the venture. Clearly the company is experimenting in its efforts to find locations that will yield the necessary volume.

30. COMPANY PROBLEMS ARE BUSINESS PROBLEMS

The critical problems of Standard Auto Service Corporation executives, therefore, are strictly business ones. Will the lower charge for car washing and the quick service at a given location attract a sufficient volume of steady business to allow the potential economies in the process to yield a satisfactory profit? Further, will the probable profits at each location warrant the assumption of the risks inherent in such highly specialized investment? In their consideration of the economic principle of labor specialization and the technicalities of its application to automobile washing, these executives have to reach decisions in terms of business concepts: cost of performing the service, volume of business obtainable, effect of volume on costs, and financial ability of the company to carry the venture through to such time as it can reasonably be expected to yield a profit.

Industrial management is much more than a matter of production technique. Production techniques are important, but the problem of the industrial executive is to employ them to the end that a business profit be obtained. The business characteristics and implications of production techniques are, therefore, the critical considerations. Any attempt to understand economic principles of production and the techniques of their application involves focusing of attention upon the business aspects of production. The industrial executive is primarily a businessman. His understanding of production problems and methods enables him to produce a product or service so attractive in the market that the public will pay the requisite price in volume sufficient to yield a profit.

31. LABOR SPECIALIZATION IN WARTIME

If one were to attempt to pick any one industrial principle to be officially cited for its contribution to the amazing industrial accomplishment of the Second World War, the chances are that the simple concept of labor specialization would be the recipient of the honor. There is no question but that more jobs were subdivided into more simple tasks than had ever been the case before. Three conditions inherent in the character of wartime production were responsible: in wartime the number of skilled workers available is tragically less than the number demanded by the war effort; the time element of the war demand allows no margin for the training of skilled workers and very little for training inexperienced workers to perform semiskilled tasks;

and, finally, cost of production becomes of secondary concern. These three—the volume required, the demand for quick delivery, and the lessened emphasis on cost—create an abnormal situation which tends to maximize the benefits of labor specialization and to minimize the evils of what would normally be considered overspecialization.

Overnight the Second World War required a ten-thousandfold jump in the demand for electronic crystals. There probably was not a score of skilled crystal makers with the requisite know-how in all the United States; the condition was critical, and "best minds" went to work on it. They shortly came up with a simple but highly effective answer. Careful study of the total job revealed that one small fraction of the task called for a degree of skill that could be acquired only by a few people with special aptitude by means of months (perhaps years) of training and practice. The rest of the job could be broken down into small tasks that could be learned in a few days, sometimes in a few hours, by people who had never seen the inside of a factory before. By confining the few skilled craftsmen to that small part of the work for which their skill was required and training inexperienced workers to perform the other tasks, it was possible to meet the terrific wartime demand for this essential item, and to meet it quickly. There probably was no more dramatic instance of the contribution of labor specialization to the war-industry effort.

The wartime grinding of optics, lenses, and prisms is another instance of separating a composite into its skilled and unskilled components, confining skilled workers to tasks that constantly called for the application of their skills, and breaking down the remainder of the work into tasks so simple that the inexperienced could master them quickly. When the arsenals and Navy yards placed a call with the government employment service for 350 qualified lens grinders it was impossible to locate such competent skilled craftsmen. A careful study of the trade revealed the possibility of specializing the work. The fully competent lens grinder was supposed to be able to perform successfully any or all of 20 tasks, of which the following are typical:

1. Cut optical glass
2. Grind all types of lenses
3. Grind all types of prisms
4. Grind reticles
5. Grind windows or covers
6. Correct prisms for polish
19. Cement ocular prisms
20. Roof prisms (correction)

Study of the operations required for the production of one type of military prism (task type 3 in the foregoing list of 20) showed that it could be broken down into 15 separate operations. The first of these, grinding one side individually by hand to establish a base for subsequent operations, could be taught an inexperienced worker quickly. The last two operations, beveling to a 45-degree angle and hand correction, required considerable skill and experience. None of the operations called for the over-all skill possessed by the highly versatile craftsman competent to perform all the 20 complete tasks listed above. Careful selection of workers, training to perform one specific operation, and use of people possessing skill only when skill was required made it possible to meet the tremendously expanded requirements of the armed services.

Under wartime pressures, practically all metalworking shops forsake the use of skilled machinists in favor of little-skilled or unskilled machine tenders. By means of ingenious machine fixtures, jigs, and attachments, the man who runs a machine becomes in essence a specialist in putting pieces into a machine and taking them out when the machine has completed its work on them. Sometimes even this task is broken down into two parts: one man loads the machine while a second man unloads it. In this way the time during which the machine is idle while being loaded and unloaded is reduced and its output for the day is increased. In the meantime the skilled machinists, relieved of machine operation by this device, spend all their time and energies building the machine fixtures and attachments which make the use of unskilled machine tenders possible.

Under wartime conditions there probably is no plant, large or small, directly or indirectly connected with the war effort, that does not make use of the principle of labor specialization to expand its work force and to wring the last unit of output from its machines and its skilled labor. Some of this is cost saving, but much of it is such an extreme subdivision that it tends to be costly. Handling and intraplant transportation costs increase out of proportion to volume increase. The same is true of supervision, planning, and coordinating and control costs of all kinds. But this overspecialization of labor accomplishes its purpose and is justified as a wartime measure.

When war-contract pressures end, much of this overspecialization has to be undone. Often the required volume of a single item becomes too small to support such extreme specialization, and the costs of coordinating such a multiplicity of activities make continuation competitively unwarranted. Much of postwar reconversion following both the Second World War and the Korean War has been a matter of just such unscrambling of excessive job breakdown as a part of the essential process of again becoming competitive on a cost basis.

32. CHARACTERISTICS OF POSTWAR LABOR SPECIALIZATION

One lasting effect of the wars and of the years of sellers' markets that followed has been a substantial narrowing of the spread between wage rates of skilled and unskilled factory workers. Wages of both classes have risen, but the rates of little- or less-skilled workers often have gone up faster than the rates of the more skilled. As this differential narrows, at least one of the advantages of labor specialization tends to disappear because there is less potential labor dollar saving in breaking down a job into its skilled and unskilled elements.

Another result of this wage rate change is the tendency to replace labor with equipment. The automobile laundries of the Standard Auto Service Corporation are more mechanized than before the war. Large power-driven brushes have been installed to reduce the number of workers who wash the cars with sponges and soap and water. Larger and more powerful air blowers for removing water more thoroughly from the washed vehicles have reduced the number of workers required to dry and polish. In the company's newest installations the number of hand workers has been cut by 40 to 50 per cent at low rates of operation.

Industry is one of the most highly dynamic activities of modern society. Any general economic change has its impact on the factory. And it should never be forgotten that the factory must immediately react to such impact. The effect of abnormal war and postwar conditions on the practice and application of labor specialization is a typical example of this cause-and-effect relationship. In the early 1940's we experienced a boom period in labor specialization. That was followed by a period during which the narrowing wage differentials between skilled and unskilled labor tended to reduce the gains from labor specialization. When South Korea was invaded, United States industry again was called upon to expand rapidly its production of military equipment both for the war and for large-scale defense preparation. Again labor specialization became more pervasive, because again cost was a somewhat secondary consideration and volume of output was of prime importance. Perhaps we shall see a time when fluctuation in labor specialization is only a matter of history. That is doubtful, and the successful manager is one who uses this technology intelligently in terms of existing business conditions. And business conditions are always in process of change.

QUESTIONS

1. List the arguments in favor of the inclusion of a large-scale automobile-washing plant by the Standard Auto Service Corporation at its service stations.

2. List the objections to the adoption of such car-washing systems by the company.

3. One of the advantages of the system was that it materially decreased the costs of washing a car. Make a list of all the expenses incurred by a company if it washed 400 automobiles per eight-hour day under the hand system of two-man crews. Explain in detail how each of these items of daily expense is affected by a change to mechanized large-scale washing.

4. If, on a stormy day, the volume of washing with the older type large-scale mechanized installation should decrease from the 480-car capacity output to 160 cars during an eight-hour run, how would each of the items of operating costs be affected? What would be the effect upon the cost of washing each car? Would the same results follow in the case of the two new-type installations? Explain.

5. What is the meaning of the term "overhead" [5] or, as it is frequently called, "plant burden"?

6. If the case of automobile washing is typical of most enterprises, what can we say is the effect of changes in volume of output on overhead cost per unit of product turned out?

7. How does change in volume of output affect unit labor costs?

8. What is the bearing of such consideration of the costs of operation upon the question of the desirability of adopting the large-scale washing systems in the case under discussion?

9. What are the advantages and disadvantages of the two newest washing installations with which the Standard Auto Service management is experimenting?

10. Do you think the management should have undertaken such experiments?

11. How does labor specialization aid in the industrial effort during wartime?

12. What happens to labor specialization following a war? Please explain.

13. Why did changes in wage relationships have little effect on the application of labor specialization when South Korea was invaded?

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[5] See *Encyclopaedia Britannica*, or any similar standard reference work, if not familiar with this term.

14. Will factory managers continue the practice of labor specialization? Explain.

PROBLEM 8 BRANDON BATTERY COMPANY (B)

The Brandon Battery Company manufactured dry cells, from which it made dry-cell batteries for use in flashlights, portable tube-type radios, and for other similar purposes. The company also produced flashlight cases in order to meet the preferences of its retail customers. The case department never had been profitable. Company excutives were considering discontinuing flashlight-case production and concentrating company resources on expansion of dry-cell production.

The Brandon Battery Company was one of the three largest manufacturers of dry cells and of batteries made up of a number of cells. When running at normal capacity, it manufactured 800,000 cells of all sizes per day. The manufacture of dry-cell batteries was essentially a chemical process. The work had to be planned and supervised by persons who had an understanding of the chemical problems involved, although many of the actual tasks in the productive process were simple and could be performed by girls who had the requisite dexterity, provided that they were properly supervised.

The case department in the plant was equipped with machinery sufficient to produce parts for and assemble flashlight cases in 35 styles. The production of flashlight cases was not a chemical process. Rather it involved stamping out, punching, plating, and polishing or lacquering the brass sheets which were the basic material from which the cases were made, followed by the assembly of parts. It required a different type of workmanship from that in the dry-cell department.

Distribution of company products was national in scope, with some foreign business obtained through agents. Sales were made to both wholesale and retail trade. The company's distributing organization sold batteries, lamps, and flashlight cases. Cases were considered a necessary item because dealers often wished to purchase both cases and dry cells from the same source, and it would have been almost impossible to sell one without the other. The company acted as a jobber of lamps merely in order to complete its line.

In his report, an official who investigated the situation stressed the fact that the supervisor of the case department was also the head of the machine shop, which cared for equipment maintenance, developed new machinery, made dies, etc. This man had been employed by the company for his ability in maintaining and developing dry-cell manufacturing equipment, and his problems along this line were constant and urgent. The general superintendent and the manager of the company were also principally interested in the dry-cell part of the plant.

The investigation showed that the supervision of the case department was inadequate, that the dies used in the department were poorly designed, and that manufacturing methods were inefficient. Most of these difficulties appeared to grow out of the small volume of production required of the case department. The volume was not sufficient to warrant the employment of specialists necessary to place the department upon a proper basis. The investigation further revealed that the conditions in the case department were not peculiar to the Brandon Battery Company, but were experienced by most dry-cell manufacturers who attempted the manufacture of flashlight cases.

The report recommended that the president of the company choose one of three possible solutions: (1) outside stamping contracts might be secured, thus increasing the volume of the department to a point where it would be possible to add the needed specialists; (2) the case department might be discontinued and flashlight cases purchased from outside sources; (3) the company might purchase the Manson Company, a concern which had manufactured flashlight cases for a number of years with outstanding success. The Manson Company sold cases under its own trade name, manufactured for battery companies under contract, and possessed valuable contracts for other stampings which served to balance its production. Its records indicated a flourishing and profitable business.

The Manson Company had an excellent reputation; it was common opinion in the trade that the Manson Company manufactured the best flashlight cases on the market at a cost lower than any other producer.

It was at about this time that the development of the transistor began to have an impact on the demand for dry cells and dry-cell batteries. The transistor is a very small device that replaces vacuum tubes in electronic circuits. It requires much less power than does a vacuum tube, has a comparatively longer life, and is much smaller than even the smallest vacuum tubes.

Because of its low power drain, transistors created new demands for small dry-cell batteries. This new demand came from producers of such varied products as standard and very small portable radios, photographic flash guns, moving-picture cameras, "35-mm" still cameras, light meters and other instruments, portable record players, dictating equipment, high-fidelity components such as tuners, preamplifiers, amplifiers, and multiplex broadcasting and receiving devices. This seemed to Brandon executives as a market into which the company well might move. To do this would require additional equipment and establishment of dry-cell research and product development departments.

In their exploration of this new market potential, Brandon executives met and exchanged opinions with the president and executive vice-president of the Apex Hearing Aid Company. Apex was the largest manufacturer of high-quality hearing devices in the United States. It was a pioneer in its field and had developed a fine reputation for product leadership. In the main its product development had been in the direction of reducing the size and increasing the effectiveness of its instruments.

Apex hearing aids were battery powered. In the interest of attaining its major product goals, the company had found it desirable to develop and manufacture small, relatively powerful, long-lived dry cells. Apex never had succeeded in realizing a profit on its battery production. Research and development costs were high in relation to volume of batteries required. Its need for batteries was insufficient to warrant the use of specialized production methods or standardized procedures. Apex executives recognized that this was resulting in high costs that were responsible for the unfavorable profit showing on its batteries. High-quality batteries of subminiature size were essential to the company's basic product, hearing aids. The company had been unable to locate an outside supplier experienced in the manufacture of small, high-quality dry cells and willing to undertake continuing research and development. Thus, Apex had considered producing its own batteries imperative. The company never had been willing to increase prices on its batteries as it was feared this would adversely affect demand for its expensive hearing aids.

The Brandon Battery Company never had produced miniature and subminiature dry cells. The company's investigations of the effects of transistors on a wide range of military and civilian products indicated an almost "explosive" growth in demand for this type of dry-cell battery. The new small batteries differed from the common flashlight cell as to materials used and in certain other respects. But their production involved what essentially was a chemical process and was well suited to large-scale production.

In the light of the conditions just described, it is perhaps not surprising that a series of negotiations between Brandon and Apex officials resulted in Brandon executives considering the following concrete proposals.

1. Apex would sell its battery business to Brandon and would contract not to produce batteries for a period of three years.
2. Brandon would purchase Apex battery manufacturing equipment and its materials inventory. It would hire the four research engineers and technicians currently employed on Apex battery development.
3. Brandon would supply Apex battery requirements, and Apex would take its pay for its equipment and inventories in batteries to be delivered over a period of two years.
4. Brandon would engage four engineers and technicians in addition to the four it would take over from Apex.
5. Brandon would discontinue manufacture of flashlight cases.
6. Brandon would contract with the Manson Company for its needed flashlight cases.
7. Brandon would direct all its resources and energies to becoming as outstanding in the new battery markets as it was in the common dry-cell market.

What action would you recommend that the Brandon Company take with respect to this seven-point proposal?

PROBLEM 9 NEW BUILTWELL BURNER CORPORATION

The New Builtwell Burner Corporation, a producer of oil-burning equipment, considered the desirability of adding a line of domestic quick-freezing units in an effort to reduce fluctuations in production.

The factory of the Builtwell Burner Corporation, a three-story brick building, was located at Binswood, Illinois. The framework was of steel, the floors were concrete, and the total amount of floor space was approximately 190,000 square feet. Railroad connections included the Big Four, the Nickel Plate, the Illinois Central, and the Chicago and Alton. When the factory was operated on one shift of eight hours per day, the productive capacity was 40,000 oil burners annually.

Burners were manufactured in five sizes for use in heating buildings ranging from large apartment houses, hotels, and churches to small one-family dwellings. The company's normal labor force numbered 200.

Products were distributed in the United States by 2,000 dealers and in the rest of the world by 18 general distributors. The company assisted in the sale of its products by national advertising and radio programs. Dealers also were given help in making sales, *e.g.*, the company's sales department developed standard methods of approaching various distribution problems. Dealers were supplied with this material and given assistance in its use. The latter task was both simple and effective, because all dealer helps were set up on a basis of a standardized approach. Training courses in the efficient servicing of products were maintained, and an annual sales convention was held at Binswood, which was attended by representatives from all over the world.

There was a strong company *esprit de corps*, which extended to active cooperation between plant workers and the sales force. Employees frequently assisted in selling burners in the Binswood area, going as far in some instances as to close the deals themselves. Twice a week a get-together was held during the lunch hour in the company cafeteria, attended by foremen and workers from each of the production departments, as well as by representatives of the sales force and the management. Programs on these occasions included music, "pep talks," and discussions of mutual interest. If any company dealers were visiting the plant on the days when the meetings were held, they were always present at the gatherings, where they received special recognition.

The company employed both skilled and unskilled workers, although a large proportion of the jobs were performed by skilled mechanics and machinists. The unskilled workers were paid on an hourly basis, and the skilled operators received day wages. The essential operations involved in the construction of burners consisted of high-grade machining, sheet-metal operations, and expert assembling.

Each of the major components of the product required several operations, and factory production was laid out on a process basis rather than by product. Machines of like character were grouped together. Thus, a man tending a given machine could very likely operate any other in his department. The chief production units in the plant were as follows: heat-treating, normalizing, machining, sheet-metal working, assembly, inspection, painting, and shipping.

There was little attempt made at specialization in production. No conveyor belts were used in the assembly process, and special-purpose tools and equipment were few. Most of the machines and tools were general-purpose equipment, installed with a view to achieving flexibility of output. There was no standardization of job performance, nor were incentive wage plans used; but foremen were thoroughly trained to exercise very careful supervision over both employees and the work in process.[6]

There was a pronounced seasonal fluctuation in the demand for oil burners, which the company had been able to lessen somewhat by intensive cultivation of markets below the equator where the cold season occurred during the summer of the Northern Hemisphere. At best, however, monthly sales varied widely. Accordingly, production of burners was high from August through November, fell off slightly in December, continued to be good in January, and fell gradually through March. The low months were April, May, June, and July.

After a great deal of research in which the possibilities of several products were investigated, the management decided that it might be possible to eliminate the undesirable features of seasonal operation by the introduction of a line of electrical quick-freezing units for home use. This product would have a seasonal fluctuation counter to that of oil burners, since the peak season for production of this popular product occurred from January to July of each year.

An experimental food freezing and storing unit which used a new refrigerating agent was designed. The use of this chemical presented definite advantages. The boiling point was lower than many refrigerants in use, and the gas that formed on evaporation was nonpoisonous in the quantities used in a home freezer. Any moisture that collected in the mechanism when the machine was serviced was removed by a calcium chloride dehydrator. As a result of this dehydrator feature, it was possible to perform servicing in the home of the owner unless repairs had to be made on the piston. Sulphur dioxide, theretofore a common refrigerant, was noxious in the quantities used in a freezer. Thus it was deemed unsafe to break the gas-line seal unless the serviceman wore a gas mask, and whenever the seal was broken the unit had to be subjected to a 48-hour dehydrating baking. Any moisture in excess of 0.0005 per cent in a sulphur dioxide freezer formed sulphurous acid and "froze" the working parts of the machine. The chief disadvantage of the new chemical was that it filtered through an ordinary casting to such an extent that the charge soon evaporated. This difficulty was eliminated by the use of special nickel-steel alloy castings

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[6] For a more detailed description of the manufacture of oil burners, see Exhibit 1, p. 101.

After extensive tests to establish the mechanical efficiency of the various units, the company put into production a complete line of home quick-freezing units which ranged from a capacity of 4 cubic feet for apartment use to 20 cubic feet for use on farms and in rural communities.[7]

Exhibit 1 Manufacture of Oil Burners

Essential parts of an oil burner, of the type made by the New Builtwell Burner Corporation, were the motor, shaft, oil-circulating pump, fan, air volume control, atomizing device, oil-feed metering unit, automatic shutoff valve, oil strainer, draft pipe, nozzle, ignition device, and transformer. Moving parts were designed so that one shaft on the motor supplied all necessary power.

In large part, processes through which raw materials went were determined by type of raw material. Gray iron, brass, and alloy castings were first normalized by a heating operation in which stresses and strains within castings were equalized. They then proceeded to the machine shop where they were turned, milled, drilled, tapped, and ground on general-purpose machine tools. After these operations, parts were ready for a test in which high pressure was applied to make certain that there were no weak places or leaks in them.

Parts made from steel bar stock were heat-treated. Essential steps here were carburizing, quenching, or tempering. Bar stock of brass did not undergo heat-treatment, but, otherwise, steel and brass bar stock were subjected to similar operations. Ordinarily, these bars either went through automatic screw machines and hand screw machines or were milled, drilled, tapped, and inspected.

Sheet metal was subjected to square shearing, blanking, piercing, rolling, stamping, and breaking. Some sheets were seamed to form the pipe which conducted oil and air to the combustion chamber. There was also some spot welding being done in the sheet-metal department.

Parts for various units that made up the burner were fabricated from castings. All units were enclosed. The centrifugal vane pump, the air fan, the diffuser, the oil meter, parts of the housings, and the strainer were fashioned from sheet metal. The shaft, parts for valves, toggle arms, and the like were made from bar stock. Brass castings and steel castings were used for various small parts.

Certain items featured by specialty companies such as oil cups, pipe fittings, gauges, and special fittings were purchased from independent manufacturers. In addition, standard lines of hardware universally catalogued and made by specialists were purchased. Finally, the New Builtwell Burner Corporation purchased motors, die castings, and transformers.

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[7] For a detailed description of processes and work involved, see Exhibit 2, p. 102, on the production of quick-freezing units.

Exhibit 2 Production of Quick-freezing Units

The chief parts of the refrigerating unit of the freezer were two motors (one for the compressor and one for the fan), a condenser, float valve, fan assembly, dehydrator, various shutoff valves, oil trap, crankcase, dome, flapper valve, liquid receiver, condenser housing, cooling unit, and thermostatic control.

Raw materials for parts manufactured were similar to those used in production of oil burners. All castings which came in contact with gaseous methyl chloride had to be made of a special nickel alloy steel. Gray iron and brass castings were used and bar stock of steel and brass.

Parts made from castings included the dome (or motor housing), the condenser housing, the eccentric for the piston, the piston, and the cylinder. The cylinder was made of cast iron with a special steel lining. Parts made from bar stock included valve stems, seats, fittings, and motor shafts. Sheet-metal parts were the oil trap housing and float, the liquid receiver, and the fan. The connections were made with copper tubing.

Castings were normalized to equalize internal stresses and strains, and were then turned, milled, drilled, tapped, and ground. They were then subjected to pressure tests. Bar stock of steel or brass was either run through automatic screw machines and hand screw machines or it was milled, drilled, tapped, and inspected.

Sheet metal required was square sheared, blanked, pierced, rolled, stamped, and broken. In case of steel stock, it was heat-treated and in this process underwent carburizing, quenching, and tempering.

Parts purchased by the company included two types of induction motors, condenser, cooling unit, and various specialties which could be manufactured by independent producers at a far lower cost. In addition, all cabinets were purchased from outside manufacturers who specialized in refrigerator and freezer-cabinet production.

QUESTIONS

1. What advantages should the New Builtwell Burner Corporation realize from the addition of quick-freezing units for domestic use to its oil-burner line?

2. With what disadvantages should the company be prepared to deal?

3. What alternatives, other than the addition of an offsetting seasonal product, would you suggest that company management should have considered?

5

PROBLEMS OF APPLICATION OF THE SPECIALIZATION CONCEPT

LEWISTON TRANSPORT COMPANY

1. AN ILLUSTRATION OF THE GENERAL APPLICABILITY OF THE SPECIALIZATION CONCEPT

The Lewiston Transport Company which operated an extensive trucking business was experiencing a decline in volume of business with an even more rapid falling off in profits. A consideration of general business conditions, competition in the trucking field, and the character of the company's operating costs convinced company officials that drastic internal economies and reorganization were imperative. A program largely based upon extensive application of the specialization concept was devised, thoroughly tried out, and found effective in restoring to the company its former profit-making ability.

2. PERVASIVENESS OF SPECIALIZATION IN INDUSTRY

Success in application of the concept of specialization in the field of labor has led to its extensive utilization throughout the industrial organism. Today we hear of specialized equipment, specialized plants, process specialization, product specialization, and even of management specialization. Rarely does a company embark upon a program limited to any one phase of specialization activity. Even when the original intent is specific within some one of these, or other, fields, the development of a working plan soon reveals relationships which involve many functions or activities.

3. INTERRELATION OF THE VARIOUS APPLICATIONS OF THE SPECIALIZATION CONCEPT

Labor specialization is closely related to equipment specialization. The more general the purpose of a machine, the less likely is it to be operated by only one man. Even when one operative is assigned exclusively to a general-purpose machine, he rarely specializes in one type of operation on that machine. As a rule, the more flexible a machine in its actual and potential capacities, the more adaptable and unspecialized its operative will be.

Product specialization and process specialization go hand in hand. The less the variety of finished product turned out in a plant, the fewer will be the processes carried on within the plant at any one time. The fewer the processes carried on, the smaller the number of types of jobs involved. The fewer the job types, the greater the amount and degree of labor specialization. Specialized equipment usually entails careful planning and control for its most effective utilization, and detailed specialization of management naturally ensues.

4. ANALYZING THE RESULTS OF SPECIALIZATION

It is usually difficult in practice to differentiate in a single case between results obtained from labor specialization and from the specialization of related factors and activities. That each plays its part and produces certain results will be evident upon careful scrutiny. But to evaluate those results quantitatively is rarely possible. That this is so is of little concern to the management, whose objective is the improvement of the relationship of the parts that contribute to the whole. From the standpoint of the student of modern industry, the important things are (1) to sense the pervasive quality of the specialization principle; (2) to recognize it in its sundry applications; (3) to grasp the import of the relationships involved; and (4) to evaluate the results obtained, the weaknesses, and the dangers incident to specific applications.

5. EXPERIENCE OF THE LEWISTON TRANSPORT COMPANY

The following experience, that of the Lewiston Transport Company, is set forth here in considerable detail as an illustration of what one usually finds in any specific study of specialization in modern industry.

The Lewiston Transport Company, located in a large Middle Western city, operated one of the largest trucking businesses in the United States. Within the city, the company operated a fleet of heavy trucks which delivered freight from shipping terminals and wholesalers' warehouses and which collected freight for delivery to railroad, steamship, and long-distance trucking companies for shipment. Suburban service of this type was rendered within a radius of 30 miles. The company also operated delivery-truck fleets for several large department stores. As a result of depressed business conditions, the company faced a situation of decreased volume of business and narrowed profit margin. Solution of the problem was sought in more efficient and attractive trucking equipment, control of loading to improve load factor, and specialization of labor, equipment, process, and management.

6. EFFECT OF DECLINE IN VOLUME OF BUSINESS ON EQUIPMENT UTILIZATION—MANAGEMENT SPECIALIZATION AS A REMEDY

The decline in volume of business obtained had adversely affected the efficiency with which automotive equipment was utilized. Frequently trucks were not loaded to capacity, and as a result the load factor had fallen. To remedy this situation, a foreman was detailed to give his entire attention to the loading, dispatching, and routing of trucks. Small loads were brought together at central points by light high-speed trucks. There they were consolidated and dispatched in full-load lots. In this way trucks were kept loaded at or near capacity, and duplication of deliveries over the same route was avoided. The detailing of a foreman to give his entire time to the loading, dispatching, and routing of trucks was an excellent example of modern practice in the matter of management specialization.

7. MANAGEMENT SPECIALIZATION ILLUSTRATED

It is still not unusual for a departmental foreman in a small shop to have broad responsibilities and authority. He trains his workers, assigns them to tasks, disciplines them, promotes them, and discharges them upon occasion. He is responsible for the condition and use of machines and tools within his department. He requisitions from the storeroom his needed raw materials. He plans the work required of his department, determining by whom and when the various tasks are to be performed, in such a manner as to ensure the completion of jobs within the time limits available for the various orders. He has a score of other responsibilities to discharge: proper utilization of materials, inspection for quality, the compilation of information requisite for payroll and cost records, and many others. His responsibility and authority are fixed, in major part, in terms of the physical extent of his department. Other foremen discharge similar functions for other areas within the plant. Foremanship as a part of management is thus organized as a specialized job, the basis of organization being plant operating departments.

8. SPECIALIZING MANAGEMENT ON THE BASIS OF FUNCTIONS PERFORMED

Under certain circumstances it has been found desirable to depart from this basis of foremanship specialization. It is common practice to specialize the *function* of part and product design and specification, thus relieving the operating department foreman of all responsibility in this respect. His job, as regards these functions, is limited to following instructions—the execution of orders. Not often is an operating department foreman charged with the generation of power utilized within his department, nor is he required to purchase the materials and supplies which his workers use.

In recent years, the concept of specializing management on the basis of functions rather than in terms of plant areas has been extensively applied where the relationships involved permit. It is not at all uncommon to relieve the foreman of the task of planning what should be done at a certain time within his department. Occasionally in highly centralized scheduling departments, this task may go even to the extent of specifying not only times but also machines and operatives to be employed on particular jobs. The problems of scheduling are thus centralized in the hands of specialists, frequently with attendant advantages similar to those resulting from the specialization of the function of truck loading, scheduling, and routing in the experience of the Lewiston Transport Company.

9. RELATION OF MANAGEMENT SPECIALIZATION TO EQUIPMENT AND LABOR SPECIALIZATION

The company's improvement in dispatching made possible increased use of trailers, with a consequent reduction in labor costs. Both truck drivers and their assistants were members of the local chauffeurs' union. Both received high wage rates as skilled operatives although all the assistants' and much of the chauffers' time was occupied in the unskilled tasks of loading and unloading.

Twice in the past the company had attempted to replace drivers' assistants with nonunion common labor. On both occasions the union had fought the move so vigorously that the management had been forced to abandon the plan.

The use of high-speed truck tractors and trailers improved this situation. The truck tractor and trailer combination consisted of two or more units. The tractor was a truck of short wheel base and without a body. The loads were carried in the trailer units. In operation, the tractor was coupled to a trailer unit which had been loaded previously. The tractor then hauled the trailer to its destination, where it was uncoupled. Often the tractor did not wait for the trailer to be unloaded but at once picked up an empty trailer, hauled it back to the point where it was to be loaded, uncoupled it, immediately picked up a loaded trailer, and went out again. In this way, the tractors were kept in operation a large part of the time, and only the trailers were idle during the loading and unloading periods. The major part of the chauffeur's time was utilized in driving since it was unnecessary for him to wait for trailers to be loaded and unloaded. Also it was often possible to replace the chauffeur's assistant with a loader who was hired as a common laborer at the warehouse or terminal and as such was paid lower wages.

The chauffeurs' union had no jurisdiction over loaders who were more or less permanently stationed at dispatching and receiving points, and thus it was no longer able to push its demands that such work be done by members of that union. As all the tractor drivers' time was now occupied in driving, there was no need for chauffeurs' assistants when tractors and trailers were used. Thus the company was able to specialize the jobs of loading and driving, to choose men best fitted for each kind of work, and to pay wages commensurate with the requirements of the tasks.

10. EFFECT OF EQUIPMENT SPECIALIZATION ON LABOR SPECIALIZATION

In this case, labor specialization had become possible as a result of equipment specialization. As a unit, the truck was essentially a dual-purpose machine: it provided carrying space and furnished motive power. Basically, it was much the same as a railroad freight train with the cars permanently attached to the engine. The replacement of trucks by tractors and trailers divided the dual function of the trucks, the power function being vested in the tractor and the carrying function in the trailer. Such subdivision of the transport job by means of equipment specialization made labor specialization possible.

11. RELATIONSHIP OF SPECIALIZED EQUIPMENT TO MASS PRODUCTION

It should also be noted that in this instance specialization of the heavy equipment resulted in its more intensive use, a result too uncommon in equipment specialization. Frequently the replacement of general-purpose machines with specialized machines so limits the use of the equipment as to render it idle to a greater extent than was true of the general-purpose device. Conditions peculiar to the Lewiston Transport Company situation freed it from this adverse effect of the use of specialized equipment. The company did not attempt to apply the principle of specialized power and carrying equipment in other than the field of heavy hauling over established routes. The varying character and demand in store delivery service made such specialized equipment unsuited to that type of work. The company management showed excellent judgment in utilizing specialized equipment for large-volume operations of repetitive, slightly varying nature, and general-purpose equipment in situations where flexibility was required to meet fluctuations in volume and nature of the work involved. Generally speaking, specialized equipment is best suited to mass production of standard parts, products, or services which are little affected by style or seasonal fluctuations in demand.

12. REDUCTION OF LABOR FORCE IN A GARAGE MADE POSSIBLE THROUGH SPECIALIZATION OF MECHANICS

In the company's garage, 23 skilled mechanics had been employed. As jobs came in, they had been assigned to whichever men were available. Only experienced mechanics had been employed, and no attempt had been made to concentrate individual workers on specific types of work. Investigation showed that 25 to 30 per cent of the work done by these men required little or no skill in its performance.

In the reorganization of the shop, men were assigned to concentrate on specific types of work. These specialists were selected because of aptitude displayed in the past. The following assignments were made:

One blacksmith and spring repairman
One brake repairman
One motor mechanic
One ignition, starter, lights, and battery man
One iron worker and body repairman
One machinist to do lathe work and welding

One carpenter
One tinsmith, who was also to handle radiator and fender repairs
One mechanic to do testing and assist in diagnosing causes of breakdown
Two mechanics to be used for whatever purpose variations in volume of different types of work demanded
One general mechanic to work a shift from 3 to 11 P.M.
Two mechanic's helpers
One mechanic's helper who was also to act as assistant machinist
One odd-job man for use wherever needed

The supervisory force was to consist of a superintendent, a purchasing agent and stockman, and a bookkeeper.

As a result of reorganizing the jobs in the shop, the work force was reduced somewhat. Seven mechanics, one washer, and one odd-job man were released. Also, the greaser was given the job of going after needed repair parts, thus eliminating the "picker-up" who had previously been on the payroll.

13. IMPORTANCE OF VOLUME OF WORK IN DETERMINING BASIS AND DEGREE OF LABOR SPECIALIZATION

The division of the work had been carefully planned, as to both basis of specialization and degree of subdivision. The shop did not have enough spring-repair work to keep a man continuously employed at that task. The work was essentially a specialized type of blacksmithing. There was considerable other blacksmithing required in the shop, and study of past experience indicated that one man could normally just take care of all such work if spring repairs were included. The similarity of this last type of job to general blacksmithing tasks made it feasible to specialize on that *basis*, and the volume of work to be performed made the assignment of one man to all such tasks a sound *degree* of specialization.

14. SPARE PARTS AND ASSEMBLIES AS AN AID TO LABOR SPECIALIZATION IN A GARAGE

Past records showed that spring repairs did not occur with any great degree of regularity. This handicap to spring repair specialization was overcome through the stocking of spare springs and spring parts. When a spring broke, the blacksmith removed the broken member and replaced it with one from stock. The broken parts were placed in storage to be repaired whenever a slackened demand upon the blacksmith's time permitted. In this way the variations in volume of spring work were made ineffective as a deterrent to job specialization.

There was a further advantage in the shortening of the time during which a truck was idle for repair of springs.

15. ADDITIONAL EXAMPLES OF LIMITATIONS UPON LABOR SPECIALIZATION IN A GARAGE

Similar care and judgment were exercised in specializing other tasks in the shop. One mechanic was assigned to all motor repair and overhauling work other than that resulting from failure in ignition, starter, lights, or battery. These last were similar in their nature and of sufficient volume to warrant the assignment of a specialist to these tasks. The volume of valve grinding, however, was not sufficient to keep one man continuously occupied. Therefore, valve grinding was classed with other motor repairs and made a part of the work of the motor specialist. Valve grinding was not so highly skilled a task as certain other jobs of motor repair. Consequently, a semiskilled task was performed by the skilled mechanic who was required to handle the more intricate problems of motor upkeep and repair. This resulted in a relatively high cost for valve grinding. However, considering the volume of this work available and its relationship to other types of motor repairs, the assignment of the task to the skilled motor specialist was probably wise.

Careful study of the list of job assignments shows that the two cases here discussed are typical examples of practices followed in the reorganization of the shop personnel. Fluctuations in volume of work that could not well be handled in other ways were taken care of through the use of helpers and the odd-job man. Careful attention to the extent of specialization and the basis of division in terms of related functions resulted in the realization of many of the advantages of labor specialization in a setting not completely adapted to its use, without the usual attendant disadvantages.

16. A SKILLED WORKER'S REACTION TO SPECIALIZATION ON A SKILLED JOB—ONE EXAMPLE

Similar changes were made in the paint-shop personnel. The work in that shop consisted of spray painting, rubbing down and polishing, varnishing, and decorating and lettering. Much of this work did not require skill for its satisfactory performance, but it, as well as such highly skilled work as lettering, had always been done by the two expert painters employed in the shop. One of the painters was discharged, and the other devoted his entire time to the highly skilled tasks of which he was capable and which he much preferred to perform. The unskilled work was assigned to the garage watchman who was able to do it during hours on duty in which he otherwise would have been idle. This last is an example of economies to be derived from labor diversification in a situation where labor specialization was not warranted. The work of the night watchman was not similar to that of spray painting. The nature of the jobs and the volume of work were such, however, as to make it advisable to combine these two tasks as duties of one individual.

17. ATTEMPTS TO INCREASE VOLUME AS A MEANS OF MAKING SPECIALIZATION MORE EFFECTIVE

At the same time efforts had been made to increase the total volume of business obtained by the company. The rolling stock of the company offered an effective advertising medium. In the past, trucks had been repainted at intervals of three or four years, and revarnished every six or eight months. This work was done in the company's own paint shop. The management decided to varnish the trucks more frequently. Varnish preserved the paint underneath and gave the truck the appearance of being freshly painted. A trade-mark, designed to make the company name stand out attractively from the background of the truck bodies, was applied to every truck. In the past, the body-building and repair shop of the company had given little consideration to designing assemblies of cab, chassis, and body which would result in attractive lines. All emphasis had been placed on utility and durability. This policy was changed, and as rapidly as possible truck bodies were rebuilt to designs calculated to attract attention and elicit favorable customer comment upon their new graceful lines and colorings.

18. EFFECTS OF SPECIALIZATION ON LABOR COSTS IN A GARAGE

Four months after these changes were effected, the superintendent prepared a report to show labor expenditures for a week as compared with similar expenditures for the corresponding week of the previous year. A summary of that report is shown on page 113.

The management checked these figures with the weekly payrolls of the past four months and found them to be representative.

19. OTHER RESULTS OF SPECIALIZATION IN THIS CASE

No insurmountable difficulties had been encountered as a result of the changes. The amount of outside repairs required had been reduced materially. By shortening the time required for repairs, truck idleness had been cut down. An example of methods employed to effect such time saving was the use of spare motors. When a truck motor needed a thorough overhauling, which would necessitate the laying up of the truck for 24 to 48 hours, the entire motor was removed from the truck and a spare motor put in its place. This change could be made in a very short time, with a corresponding lessening of truck idleness. The policy of maintaining spare assemblies was used extensively; and a considerable stock of complete ignition units, carburetor units, spare springs, fenders, fans, wheel bearings, starters, generators, etc., was carried.

Summary of Wages Paid, One Week

Employees	Wages paid	
	After changes were made	*Before changes were made*
Mechanics	$1,995.90	$3,048.45
Painters	107.25	263.40
Coverman	107.25	115.50
Washers	412.50	790.70
General	349.20	434.70
Greasers	66.00	80.85
Picker-up		70.95
Total	$3,038.10	$4,804.55

Before changes were made	$4,804.55
After changes were made	3,038.10
Savings, one week	$1,766.45

The management realized that the spare parts and assemblies program entailed a considerable investment in inventory. However, in view of the benefits of the plan this was not deemed excessive, and it was expected that the gradual standardization of rolling stock, both as to make and to a certain extent as to type, would reduce the initial investment in inventory materially.

The Lewiston Transport Company found the foregoing proceedings with respect to truck appearance, load factor, labor specialization, and shop equipment satisfactorily effective in the improvement of company profits. The new methods employed in the shop had also resulted in improved quality of workmanship. This would have a cumulative effect which would eventually result in savings in addition to the cost reduction immediately effective from the plan.

20. SUMMARY AND CONCLUSIONS

Nature of Specialization. In large measure, the economies of modern methods of mass production find their beginnings in the specialization concept. Specialization as indicating concentration, direct approach, singleness of purpose, absence of variation, limitation of range, and intensive rather than extensive adaptation and development seems in large measure to be the stuff of which mass production as a program is made. Specialization of labor, specialization of process, plant specialization, machine specialization, and even specialization in management itself are the most common avenues of approach when things are wrong and the most commended devices when success rewards.

The Worker's Reaction to Specialization. Labor specialization is lauded as a social contribution and condemned as a social catastrophe. Not infrequently labor specialization is criticized as having bad effects upon the worker. It is said that he becomes a robot, that his work is no longer interesting, and that monotony with a whole train of evil effects follows. A study of the cases on specialization which have been treated thus far shows that any such broad generalization is false. When specialization results in confining the skilled worker to skilled work, it certainly does not tend to decrease the interest of the worker in his job. The skilled painter in the paint department of the Lewiston Transport Company was glad to confine his time to doing only the skilled tasks of which he was capable. Similarly, in the company's repair shops the restricting of mechanics and machinists to jobs in which they were most interested and to which they were best adapted did not bring about the so-called "evils" of repetitive work. Actually, the men were proud of their selection as experts in restricted fields and worked hard to further their reputations.

An Example of the Monotony of Repetitive Work. It cannot be questioned that there are many occasions where a high degree of labor specialization has resulted in the creation of jobs of such simplicity as to seem to the observer monotonous in the extreme. One of the best examples of such work is that of a girl whose duty it was to make sure that cardboard containers had been filled. A machine fed rubber jar rings into small, flat boxes. The machine never made a mistake in count, but it did upon rare occasions allow a container to go past without putting anything in it. Just behind the machine sat a girl whose job it was to eliminate any such unfilled boxes. The machine ejected the filled boxes upon a mechanical conveyor which passed in front of the girl. The tops of the boxes pointed toward this worker and were open to allow inspection. Conditions were such that it was not easy to make this inspection visually; the work was best done by sense of touch. What the girl did was to insert the thumb of her right hand into each box as it passed her. If there were rings in the box, she withdrew her thumb; if there were none, she flipped the empty box from the conveyor at the time she withdrew her thumb. In performing this operation, the girl held her arm extended before her and constantly swung her thumb back and forth, in and out of the passing boxes, several times a second. This movement of the thumb was the only movement made by any part of the girl's body in performing the task. The job seemed to be a perfect example of the horror of repetitive work. No mental effort was required, and there was but a minimum of physical exertion. When questioned, the department foreman said that at one time considerable difficulty had been experienced in keeping girls on that particular job. By careful selection of workers for the task, this high turover had been reduced until it was no higher than the average for the plant. The foreman said that he was experiencing no trouble with the job and that the girls liked the work. Physically they were at rest; mentally they were far away. Conversations with workers on that particular job were convincing in establishing the accuracy of the foreman's statements. The explanation seemed to be that girls who were fitted for the occupation had been selected for the job. Undoubtedly there were many women in that plant who could not have stayed for a day on that routine, monotonous job. Proper selection of the workers, however, had resulted in getting operatives who were efficient at the work and happy with it.

That repetitive work is not distasteful to all workers has been well established by automobile manufacturers on their assembly lines. There have been many examples of worker objection to change from what they termed a soft job, a job which was in reality a simple repetitive task requiring the minimum of responsibility and mental effort.

Effect of Specialization on Skill Required of the Worker. One might reasonably say that a major objective of labor specialization is to fit the job to the worker. In the larger number of cases it is probable that labor specialization has reduced the skill required of the workers. The reduction of a complex task into its simple components often means that none of the more highly specialized workers need have the breadth of skill required of the worker who performed the task before it was broken down. When labor specialization has been opposed, it has usually been on the score that management was thereby seeking to replace skilled workers with unskilled labor.

A type of labor specialization commonly found is that which seeks to break down the job in such a way as to isolate the skilled from the unskilled components, or to separate different skills. When jobs are specialized in this way, it frequently becomes profitable to employ more highly skilled workers than were employed before the task was broken down. Prior to specialization, the worker was paid a wage rate commensurate with the greatest component skill required even though much of his time was spent on work that could have been performed equally well by less skilled workers commanding lower wages. Under such circumstances the employer was unlikely to make the effort to find, or pay wages that would attract, the most able workers. When the task is broken down and the skilled operations are separated from the unskilled, the employer often finds it advantageous to pay a wage sufficiently high to attract the most skillful workers to those specialized operations calling for skill.

When the unspecialized job calls for the exercise of a combination of several diverse skills, the employee chosen is likely to be a Jack-of-all-trades, not highly skilled in any of them. Specialization of such a job into tasks each of which calls for but one type of skill makes possible the employment of highly skilled workers to replace the all-round worker used on the unspecialized job.

It is a mistake to assume that labor specialization is necessarily a process of replacing skilled workers with unskilled ones. From the management standpoint it is essentially a business problem. When breakdown of a job results in tasks suited to unskilled workers, management usually finds it profitable to man these operations from this broader labor market. When the new job specifications call for continuous employment of skill by the workers, management will seek the most skillful applicants because it is profitable to do so.

Essentially it is a matter of economical use of labor and the wage dollar. Usually the greatest gain is to be had by defining tasks in terms of labor capacity and availability, the right job for the right man.

Effects of Specialization on Wage Rates and Earnings. Labor specialization has been criticized as a device of management for paying lower wages. Specialization of labor does not always mean lower wages. As has been pointed out, often it results in the utilization of more skillful, higher wage workers. Furthermore, even though less skilled operatives are used, the increased productivity of these workers often makes possible payment of higher wages to the individual than he would otherwise receive. Low labor costs and high wage earnings are not incompatible with labor specialization.

Risks of Equipment Specialization. The risks inherent in equipment specialization are usually greater than those which must be dealt with in labor specialization. When a worker is specialized on one simple task, no long-time commitment is ordinarily made. The job may be discontinued or the task changed, and the operative can often change with it. When a single-purpose machine is purchased in preference to a more general-purpose mechanism, an irrevocable decision has been made. The highly specialized machine can do one job and do it superlatively well, but that is all it can do. It may be a beautifully engineered precision mechanism, highly efficient at its appointed task, but when that job is gone or substantially changed, the machine—though still strong, unworn, and accurate—is worthless. The employment of specialized plant and equipment in industry is accompanied by varying degrees of risk of change. Maximum use from the day of its installation is of great importance with the specialized machine.

Losses and Gains from Plant and Process Specialization. The advantages and disadvantages of plant and process specialization are essentially similar. Both are closely related to determination of product line. To produce one product in a single complete plant is the acme of the production expert's idea of efficiency. Such an ideal is rarely attainable or desirable from the profit viewpoint. The chief advantages are those which grow out of resulting simplicity: effectiveness of single-minded purpose, ease of control, applicability of other types of specialization, and the benefits that accrue therefrom. Among the disadvantages are the risks of change and the unwillingness of the consumer to adapt himself to the dictates of ultra-efficiency in processing. From the standpoint of the market and its financial implications, putting all the eggs in one basket may place a tremendous stress on that one basket, to say nothing of the strain of eternal vigilance on the part of management. Specialization has its drawbacks.

Two Common Types of Management Specialization. In the field of management personnel, specialization is essentially a problem of basis and degree. Fundamentally, there are two bases upon which management may be subdivided to accomplish specialization: (1) functions to be performed, or (2) areas of responsibility with little restriction as to functions. The diagram shown in Exhibit 1 (page 118) is a simple means of demonstrating these two bases of specializing management.

In a plant consisting of a foundry, a forge shop, a machine shop, and an assembly shop, the following functions, among others, are performed: purchasing, planning, scheduling, inspection, labor control, and maintenance. The departmental subdivisions—foundry, forge, machine shop, and assembly shop—are divisions in terms of plant areas. Purchasing, planning, scheduling, inspection, labor control, and maintenance are management functions which must be discharged within each plant area.

Exhibit 1 Zones of Authority in Line and Functional Types of Management

Line type					Functional type				
	Foundry	*Forge*	*Machine shop*	*Assembly*		*Foundry*	*Forge*	*Machine shop*	*Assembly*
Purchasing	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Purchasing	xxxxx	xxxxx	xxxxx	xxxxx
Planning	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Planning	xxxxx	xxxxx	xxxxx	xxxxx
Scheduling	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Scheduling	xxxxx	xxxxx	xxxxx	xxxxx
Inspection	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Inspection	xxxxx	xxxxx	xxxxx	xxxxx
Labor control	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Labor control	xxxxx	xxxxx	xxxxx	xxxxx
Maintenance	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	Maintenance	xxxxx	xxxxx	xxxxx	xxxxx

The Line Type of Management Specialization. The job of managing the complete enterprise may be broken down in two ways. If the breaking down is to be in terms of plant areas, an executive, likely to be called the foundry superintendent, is placed in charge of the foundry. His job is to supervise all the functions—purchasing, planning, scheduling, inspection, and so forth—within the foundry department. He is responsible for all these activities, but only to the extent that they are carried on within his departmental area, the foundry. Another executive, the forge shop superintendent, has a like task within the confines of the forge shop and is responsible for all functions within that departmental area. A machine shop superintendent has a similar responsibility within his area. The superintendent of the assembly department has comparable responsibility. These four superintendents are specialists: a foundry management specialist, a forge shop specialist, a machine shop specialist, and an assembly division specialist. None of them is a specialist in terms of the six functions portrayed in Exhibit 1: purchasing, planning, scheduling, inspection, labor control, maintenance. They are specialists in terms of plant areas only. The vertical *x* lines in the diagram show the zones of authority in this type of specialization, which is commonly spoken of as *line type* of organization in business management.

Exhibit 2 shows the same division of responsibility and authority in the more common organization chart form.

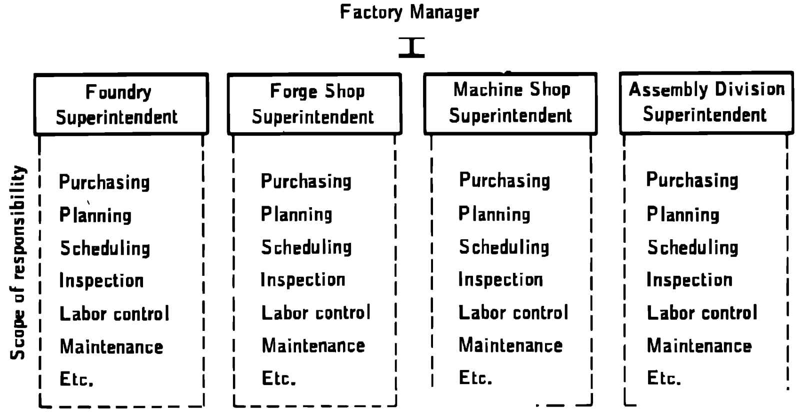

Exhibit 2. Organization Chart Showing Line Type of Specialization of Management.

The Functional Type of Management Specialization. A second method of specializing the job of managing this enterprise is to use the functions performed in the various departments as the basis for breaking down the task of management. An executive, called the purchasing agent, is placed in charge of purchasing activities for all four departments of the plant. He is responsible for effective purchasing for the foundry, the forge shop, the machine shop, and the assembly division. His function is purchasing, and it cuts across all plant department lines and is coextensive with the limits of the enterprise as a whole. Planning is similarly specialized. One executive is charged with the responsibility of effecting all planning for all departments: foundry, forge, machine, and assembly. Another executive is similarly in charge of all scheduling. A chief inspector is in charge of inspection in all four departments. A personnel manager is given responsibility for personnel control without limitation as to departmental lines, and similarly maintenance for the entire plant becomes the responsibility of a chief engineer. Such division is in terms of functions performed rather than in terms of plant areas and is commonly spoken of as the functional type of organization. The horizontal *x* lines in the right half of Exhibit 1 show the zones of authority in this type of management specialization.

Exhibit 3 is an organization chart showing management specialization on the basis of function.

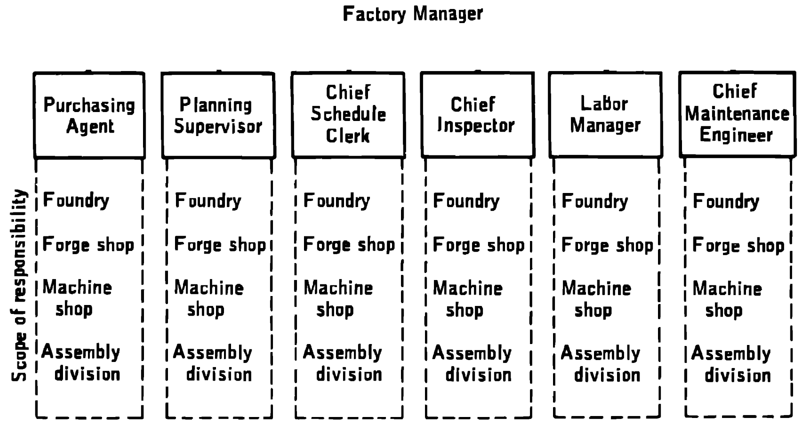

Exhibit 3. Functional-type Organization.

The Place of the Staff Specialist in Management Specialization. These are the two basic types of management specialization: line type, where the subdivision is essentially a matter of plant areas, and functional type, where specialization is in terms of functions to be performed. A third situation exists when in a line organization a functional specialist acts in a purely advisory capacity either to his senior executive or to junior executives, or both. Such an advisory specialist is usually referred to as a staff officer and is one of the essential elements in the line and staff type of organization.

Determination of Basis and Degree of Management Specialization. Selection of the proper basis of management specialization and the degree to which such specialization can be most advantageously carried on are organization problems of utmost importance. There is no one best form of management organization applicable to all businesses, nor will any one form of organization continue indefinitely to be best suited to any one business. In modern management some degree of specialization is practically always necessary.

The extensive state and Federal labor legislation of the past 25 years has practically forced an increase in specialization of labor management. Governmental regulation in the form of new laws and their administrative interpretations (sometimes conflicting) has put the knowledge and understanding required for intelligent and safe compliance beyond the time and experience scope of most foremen and supervisors. Thus it has become common to place the responsibility for labor management in the hands of specialists. In some companies labor management itself has been subdivided, and not infrequently companies have specialized labor relations managers, personnel directors, employment directors, and training directors. This forced specialization has often yielded the common advantage of more expert performance of each of the subdivisions. At the same time it has too frequently been accompanied by an unfortunate isolation of parts which are essentially one whole and, what is even more serious, by the divorcing of labor relations from the line operating functions where the true causes of worker satisfaction and dissatisfaction are to be found. Many executives have recognized this evil clearly but have believed that the drastic changes brought about by new government controls gave them no choice in the matter, at least until the new rules of the game were more generally agreed upon and commonly understood. However, there has been a general tendency in this country to overspecialize management, and excessive specialization will eventually weaken an organization just as surely as lack of specialization will render it immediately ineffective.

Of all the problems of industrial management, those which have to do with the creation and maintenance of effective organization call for the greatest maturity of understanding, thought, and judgment. For that reason the subject of organization, though usually treated early in an industrial management discourse, will be deferred until late in this volume. It is hoped that discussion of some of the varied problems of the industrial executive may serve as preparation to the solution of issues that have to do with the building up of effective executive organization.

Specialization, the Basis of Management Control. One earmark of modern professional-type management is control, that is, the measurement of results in the interest of better planning, organizing, and motivating. Measurement by comparison is the most universally applicable mode. This involves the presetting of standards in relation to which outcomes can be evaluated. Specialization in its various applications has done much to increase management's ability to develop standards for measurement. The more complicated, the more diversified, the more changing the task, the more difficult it is to set a standard for it. Specialization makes for simplicity, for nonvarying procedure, for repetition of method, for isolation of variables. By so doing it increases management's ability to set reliable performance standards. Without standards, measurement—in the real sense—becomes impossible. Control through measurement is a pervasive goal of able business executives of today.

Specialization, the First Principle of Modern Industry. Without prejudice, it would seem that one might say that specialization pervades modern industry. Sometimes it is in one field or function; usually in many. Specialization produces good results and bad. The outcome is largely the result of relationships peculiar to each individual case. The creation and maintenance of relationships which bring about good results are tasks of management. And management in the fulfillment of these functions finds it expedient to call to its aid one of the very forces it seeks to control, specialization.

QUESTIONS

1. In their efforts to reduce costs during a period of business recession the managers of the Lewiston Transport Company had one of the foremen spend all of his time planning the loading, dispatching, and routing of its trucks. When doing this work was the foreman managing? Please explain. Was he a functional specialist or a plant area supervisor? How would you measure his effectiveness on this job?
2. Does the Lewiston Company's use of truck tractors and tractor drawn trailers help or make more difficult the work of the planning foreman?
3. Explain the relationship between equipment and labor specialization. Illustrate by citing examples from the Lewiston experience.
4. Explain the relation between volume and specialization, again citing examples from the Lewiston case.
5. Explain in some detail how the application of the specialization concept enabled the managers of the Lewiston Company to reduce costs in its garage.
6. By citing examples from the company's garage, distinguish between "basis" and "degree" of specialization. Are these two concepts interrelated?
7. Be prepared to discuss the impacts of specialization on workers with respect to the following:

a. Attitude toward their jobs
b. Monotony
c. Skill requirements
d. Workers' earnings
e. Availability of jobs
f. Standard of living

8. What relationships, if any, are there among labor, product, plant, process, and equipment specialization?

9. How do various types of application of the specialization concept affect management's ability to control through measurement?

10. Draw an organization chart for a company having the same major plant departments and management functions as are shown in Exhibit 1. Break down the labor-control function into two parts: industrial relations and personnel management. Subdivide personnel management into three sections responsible to the personnel manager: employment, safety, and training. Show purchasing, planning, industrial relations, and personnel management as if they were organized functionally. Show other activities as being organized on a line basis. Use the type of organization chart shown in Exhibits 2 and 3. If correctly drawn, your chart will show the type of management organization known as "line and staff," a combination of functional organization with line organization.

11. What is "specialization"? Why has it been referred to in the text and questions as a "concept"? In what respects, if at all, is it appropriate to call it a "principle"?

PROBLEM 10 LOMAX MACHINE WORKS

In an effort to reduce competitively high direct labor costs, the management of the Lomax Machine Works installed a costly automatically controlled combination milling, drilling, boring, and cutting machine.

One department of the Lomax Machine Works was equipped with milling machines and multiple-spindle drill presses. Each operator in the department was capable of running any machine in the department. Standard times had been determined for all jobs performed in the department, and the machinists were paid piece rates. The base rate for all department workers was $1.90 an hour. If the standard time for a job was six minutes, the piece rate was 19 cents. If an operator produced 12 pieces in an hour, his pay for that hour was 12 × $0.19, or $2.28.

If an operator was assigned the job of milling a standard lot of 100 pieces of a part, he first set up the machine to do the job. This consisted of mounting the proper cutting tools on the machine and adjusting them, attaching and adjusting the proper workpiece holding device on the milling machine table, setting the proper speeds, feeds, and cuts at which the machine would run, and making a trial run of a part on the machine to check the accuracy of the machine setup. This work required considerable skill so that the part would be machined to the dimensions specified.

After the machine was properly set up for the job, the machinist milled the lot of 100 pieces. To do this he would place an unmachined casting in the work-holding fixture on the machine. This was done quickly as there was only one way in which the part would fit into the fixture. He then closed a clamp on the fixture which held the workpiece accurately in position while it was being milled. He started the machine cycle by pushing a button, after which the machine operated automatically until the cut was completed when the machine stopped itself. The operative then unclamped the fixture and removed the workpiece. He repeated this cycle of load, start, and unload until all 100 pieces in the lot were machined. No skill was required for the load-start-unload cycle.

After the lot was completed, the machinist removed the cutters and holding fixture from the milling machine and returned them to the department tool crib. He then was ready for another job.

The standard time allowed for milling 100 "control arm brackets" was 480 minutes made up as follows:

Obtain blueprint, cutters, and fixture	10.0 minutes
Mount cutters on machine arbor	34.0
Set up fixture and adjust	10.0
Check setup, mill one piece	5.6
Mill 99 pieces	356.4
Break down setup and return drawing, cutters, and fixture to tool crib	16.0
Allowance for personal needs, rest, and interruptions	48.0
Total time	480.0 minutes

A worker who completed this task in 400 minutes would be paid $15.20 for the work. The labor cost to the company would be 15.2 cents per piece.

For several years the management of the Lomax Company had tried to change the work methods in its machining departments. Tasks throughout these departments were similar to those in the milling and drill press department. Each job was done complete by skilled machinists. The management wished to have each department manned by a crew of setup machinists and a crew of much less skilled machine operators. If the base rate for setup machinists was $1.90, the base rate for suitable machine operators would be approximately $1.40 per hour. Setup crews would do nothing but set up machines and after jobs were completed take the setups down and return tools and fixtures to the tool crib. After a machine was set up properly, a machine operator would be assigned the task of actually running the lot.

All the Lomax Company machinists were members of a strong union. This union's opposition to the management's proposed change had been so insistent that the company had continued the existing procedure. The management was much concerned about its high direct labor costs of machining and continued to seek means of reducing these costs.

The development of tape-controlled machine tools seemed to Lomax management possibly to offer an approach to the problem of high machining costs. The company recently had taken delivery of such a machine with which it proposed to experiment. This machine was equipped with a variety of milling, drilling, and straight-line cutting tools. After a workpiece was placed in the machine's work-holding fixture and the machine started, the machining cycle of the machine was completely automatic. A punched tape in a control mechanism caused the machine to bring a predetermined sequence of milling, drilling, and cutting tools into operation without any attention on the part of an operator. These cutting tools were "standard" and rarely would need changing except as the result of wear. When going from one type of job to another on this machine, the setup would consist of putting a different work-holding fixture on the machine and adjusting it in relation to the cutting tools. The time required for this would be the same as that taken on the company's nonautomatic machines. Which of the machine's standard cutting tools would operate on any piece and in what sequence was determined by a roll of punched tape which the setup man would insert into the machine's control mechanism. When the machine was started, the punchings in the tape would control the selection of cutting tools to be used and their sequential action on the workpiece. The tape controlled in much the same fashion as did the punched paper rolls used on an old-fashioned automatic player piano.

A tape would be prepared (punched) for each job by a technician in the company's industrial engineering department. One of the more able technicians had learned to do this for the experimental machine. A record of the time required to punch a tape for a job had been kept and indicated that the time required for this was about twice that taken by a machinist to set up the job on the several company nonautomatic milling and drilling machines required to complete the same machining operations. All punched tapes were preserved for future reruns of the part. The technician who had learned to punch tapes was paid $600 a month.

Because a complete machining cycle on the new automatic machine included several cutting operations, the cutting cycle time per piece was much longer than the cutting cycle time for any one of the included operations when performed on a nonautomatic machine. The operator of the tape-controlled machine placed a workpiece in the holding fixture, locked it in proper position by moving a fast-action clamp, and pushed a button which started the automatic machining cycle. When the cycle was complete, the machine stopped itself and the operator removed the finished piece and placed an unmachined piece in the fixture. During the long cutting cycle the machine operator had nothing to do. At no time did he make adjustments to the machine, the tape control, or the workpiece fixture. An unskilled apprentice had been selected to run the experimental machine. He had learned the job quickly and had no difficulty with the work. He was paid hourly at the rate of $1.40. The setup work on the machine had been done by one of the department's regular machinists who had been paid at an hourly rate (equal to his current piecework earnings) for the time he spent setting up the new automatic machine.

The union was well aware of the new tape-controlled machine and the methods that had been used in setting it up and running it. They had been informed fully of the experiment at the start, knew that it was a very expensive piece of equipment (it had cost almost $100,000), and had agreed that if the setup machinist was paid hourly on the basis of his past piecework earnings that an unskilled operator would be employed to run the machine. The union representative had grumbled when informed of the experiment. But when the management had insisted, he finally had agreed to the company's terms. The machinists in the department were much interested in the new machine and frequently stopped when near it to watch its operation.

Most recently the department foreman had moved a workbench into position such that the tape-machine operator could work at it during the machine's cutting cycle. He had provided a series of small handwork jobs such as those usually provided for an apprentice's training. This pleased the machine operator.

QUESTIONS

1. What advantages does the new tape-controlled machine seem to have for the Lomax Company? Please be prepared to state these in detail.
2. What, if any, costs will increase?
3. If the experiment with the tape-controlled machine proves to be successful, what future problems do you foresee and what decisions will Lomax management have to make?

PROBLEM 11 MITCHELL-SOUTHERN MILLS

The Mitchell-Southern Mills was a cotton textile manufacturer of fine-quality high-style ginghams. Like other manufacturers of finished cotton piece goods it marketed its output through a selling agent. This commission house had sold Mitchell-Southern Mills branded ginghams for 19 years to wholesalers, cutters-up, and more recently to 1,500 retail stores. The selling house and the Mitchell-Southern brand both were held in high regard by the trade, and executives of both companies believed that the long-standing relationship between the two was of great mutual advantage. Anticipating a period of increasing consumer resistance, the selling agent was urging Mitchell-Southern executives to increase the variety of patterns to be offered buyers during the forthcoming selling season.

For years the cotton-textile industry had enjoyed an unprecedented demand for its products. Prices had risen to previously unknown heights, and during the past five years profits had been the greatest ever known in the industry. Throughout this period all mills had emphasized volume of output and in most cases had reduced drastically the number of patterns run as one means of getting the greatest possible output.

During the first six months of the current year, there had been sporadic evidences of buyer resistance to this situation in the piece goods market. There was no over-all decrease in volume of demand, but occasionally buyers for large stores and for wholesale houses would hold off purchasing for a time, apparently hoping that prices would go down. The Mitchell-Southern Mills' selling agent believed that under the circumstances it would be advantageous to increase the number of patterns to be produced for the forthcoming spring season.

For some years the mill had been producing gingham in units known as "sets" of 10,000 yards each. There was at least one set to a pattern. This permitted the company to turn out 84 patterns each season on the 504 looms in the mill. The company treasurer knew that acceptance of the selling agent's recommendation would entail increased cost per yard of cloth and would reduce output below the volume currently being attained at the mill.

Patterns for the spring season, the period of greatest sales volume, had to be in the loom the first of September. The line was shown first to the wholesalers and cutters-up and then to the retailers. While orders were being taken, a salesman often made a recommendation that a specific pattern be run, although the full pattern had not been sold. In that instance the company relied upon him to secure orders for the full set on the pattern. The patterns which were found to be poor sellers were dropped September 1, and a suggestion was made to each purchaser who had ordered a pattern which was to be discontinued that, since the pattern was not likely to be in favor, it might be advisable for the customer to change his order to more popular patterns.

The selling agent had recommended that the mill increase its number of patterns by producing ginghams in sets of 5,000 yards each to give department stores as well as wholesalers a wider variety from which to make their selection. Some salesmen suggested that a line of at least 150 patterns might be necessary. Many buyers, particularly in department stores, had been purchasing one or two pieces of 40 yards each of all patterns in a line in order to have variety and also to be sure of having popular patterns when the preference of consumers was manifested.

The Mitchell-Southern Mills ordered ginghams into manufacture in sets. There were usually 10,000 yards to a set, that number being most economical and best adapted to the mill's facilities. Greater expense per yard was incurred when the length of the set was decreased. After the threads were spun, it was necessary to determine how many threads of each color were required in the width of the cloth. A 32-inch gingham was made up of approximately 2,500 threads or ends in width. The length of these threads determined the length of a set for a pattern. If five colors of warp yarn were required for the pattern, five separate beams of yarn were made up of the requisite number of threads, each lot being wound on a steel cylinder. For a typical gingham pattern, one beam contained 500 blue threads, one beam 400 red, one beam 600 green, one beam 700 bleached, and one beam 300 black threads. In making each beam, the waste was approximately 1 yard of warp yarn. This quantity of waste was the same whether a set was only 1,000 or 10,000 yards long. Since time was lost in starting and finishing a beam whether it was to be a long or a short one, long beams saved time.

The yarn or threads on these beams next went through the dyeing process, which was generally one of the most expensive processes in the mill. Almost the same quantity of dye liquid was required to run a short set as to run a long one, and the time spent in dyeing each beam was about the same whether the beam was long or short.

After being dyed, the yarn was delivered in rope form to the beaming room where each of the five colors was put on a separate beam again. The stopping and starting of the beam required approximately an equal period of time for a short or a long length. The yarn from all five beams then was wound on one beam in the dressing department. The five beams were placed one behind another. The threads of all five were combined into one sheet 54 inches wide and were passed through a dressing solution in the slasher, which gave them strength to stand the strain and chafing in weaving. After immersion, the yarn was drawn over a drying cylinder and through a harness or comb which spaced the threads of each color to make the pattern, and then it was wound on a beam which went into the loom. This process required about 2½ hours for setting up the beams and running the ends of the thread through the harness, regardless of whether the set was long or short. A 10,000-yard set made six whole loom beams, each beam containing about 1,666 yards of yarn, which made 1,600 yards of cloth or 40 pieces each 40 yards long. A 10,000-yard set thus produced 240 pieces on six looms during a season.

In addition to extra machinery and time spent in this process for making short sets, there were losses in production and waste in the weaving department. The production time in that department was about 16 weeks. One loom during this period wove one loom beam of 1,600 yards; thus, if the mill ran one loom beam of each pattern on 500 looms, it produced 500 different patterns. If, however, it ran 10,000-yard sets, six looms were required for each set and the number of patterns produced during a season was 84, the situation at the Mitchell-Southern Mills when the selling agent of the company made his recommendation to increase the number of patterns to be produced for the forthcoming season.

Although retail and wholesale buyers sought to protect themselves against fluctuations in demand from one pattern to another by having a wide range of patterns in their lines, price also played an important part in the selection of ginghams. Retail merchants were selling at various prices that ranged from 59 cents to $1.98 a yard and purchased accordingly. If a manufacturer's price, for example, was set too high to allow a normal margin of profit when the gingham was sold at the retail price of $1.59, a retailer customarily placed the selling price at $1.69 or bought a cheaper gingham from another manufacturer to be sold at $1.59. The mill was obliged to meet the competition of both domestic and foreign producers of high-grade gingham.

To put the recommendation of the selling agent into effect would increase the cost of the cloth 3 cents per yard if the minimum for a set were reduced to 5,000 yards, 3 cents more if it were changed to 2,500 yards, and an additional 3 cents if it were decreased to 1,250 yards. This extra cost would be caused partly by the loss in waste and by production expenses in the mill and partly by increased fixed charges per yard of cloth produced at the lower volume of output.

The plan also involved the added expense in designing and in providing samples for salesmen and customers if a greater number of patterns were to be made. Suggestions for patterns were made by the selling agent's designers. Sample patterns were designed in various color combinations, and after approval by the mill, the patterns were made up in the looms to be used as samples by the salesmen and wholesalers. Annually, 12,000 yards of cloth were manufactured to incorporate designers' suggestions. This requirement necessarily would be increased to 24,000 yards if the number of patterns was doubled, with an additional cost of $10,200 per year at current prices. The mill gave away about 22,000 yards of cloth annually as samples. Doubling the number of patterns would increase the quantity to 40,000 yards, at an extra expense of $18,000 at the current prices.

An alternative plan was to increase the number of patterns by about 16 the first year, to make a total of 100. This could be accomplished by obtaining from the selling agent his selection of 32 patterns which were considered inferior to the remaining 68 that were to be run. Three looms then could be operated on each of the 32 patterns for the production of 120-piece sets. The remaining 408 looms normally could produce the 68 more popular patterns in 240-piece sets. The less popular patterns were to be run in 5,000-yard sets and repeated later in the season if their salability had been misjudged. The second year the number of patterns could be increased again to perhaps 110 and the run of 20 more of the less popular could be shortened.

Selection of the patterns to be run in 120-piece sets was to be delayed until sales could be estimated as accurately as possible. The additional cost of short-run patterns would be prorated to other patterns.

The treasurer of the Mitchell-Southern Mills, however, decided not to increase the number of patterns. He believed that current demand would continue for some time and that the salesmen were prone to exaggerate the need for an extensive variety of patterns, or to use the lack of numerous patterns as an excuse for not making sales. He knew, moreover, that although patterns and style were important considerations to retail consumers, the purchases of retailers and wholesalers also were affected greatly by price. The increase of 3 cents a yard above the present wholesale prices might increase buyer resistance. The primary consideration, however, was the strength of the demand for gingham. During the past year ginghams had been in such demand that the Mitchell-Southern Mills had experienced no difficulty in selling its entire output, with only 84 patterns. It seemed to the mill managers unwise, therefore, to increase this number, especially in view of the fact that such diversification would impede production and increase costs.

QUESTIONS

1. What disadvantages would Mitchell-Southern Mills experience if the number of patterns manufactured was increased?
2. What advantages would accrue?
3. In your opinion was the decision to continue the specialization policy sound, or should the management have diversified the company's product line?

PROBLEM 12 WILKENS-BELDEN MANUFACTURING COMPANY (B)

The Wilkens-Belden Manufacturing Company was having difficulty in hiring enough machine operators. The methods- and time-study engineering department suggested diversification of the work of some of the company's employees as one means of meeting the worker shortage.

The Wilkens-Belden Manufacturing Company was having difficulty in keeping its delivery promises. The reason was the large backlog of orders that had accumulated as a result of an abnormally large sales volume.

The company had taken many steps to increase output. Further increase in capacity seemed limited by inability to hire additional workers. For some time the company had followed the practice of having a machine operator on a machine with a power feed run a second similar machine whenever possible. On many power-fed machines the operator had nothing to do during the time the machine was running. When time study of the operation showed that the machine running time was longer than the time required for the operator to unload a finished workpiece from the machine and reload the machine, it was possible for the operator to run a second similar machine. This had been done whenever a second similar machine on a similar operation was available. The operator gained because of higher earnings, and the company gained from the greater output from the same work force. Opportunities for increasing output by this method had been exhausted.

Exhibit 1 Wilkens-Belden Manufacturing Company (B)

Time-study Data Sheet—Grinding Operation

Description of Job: Grinding face of access plate on surface grinder

Element No.	Element	Time, hundredths of a minute										
		Cycle										*Average*
		1	2	3	4	5	6	7	8	9	10	
1	Pick up piece, adjust in fixture, start machine........	61	58	57	64	54	59	55	61	58	59	58.6
2	Grind; use power feed	83	84	83	83	82	84	83	83	82	83	83
3	Remove piece from fixture and put aside...........	28	27	29	28	26	28	27	28	28	27	27.6
	Total............	172	169	169	175	162	171	165	172	168	169	169.2

One of the time-study engineers who had been on the machine-assignment program pointed out that there still were many instances where an operator could tend a second machine if the second machine was different from the first machine. To illustrate his point he showed the superintendent of the light machining department the time-study data he had compiled on two jobs that were being done by two different operators in that department. The first of these was the job of grinding the face of access plates on a surface grinder. Exhibit 1 shows times taken on 10 cycles of this operation.

The time-study engineer pointed out that when the machine was running under power feed (element 2 in Exhibit 1) the worker was idle. He could not run a second grinder on this same operation because the time required to load and unload the machine (elements 1 and 3) averaged 0.862 minute.

Exhibit 2 **Wilkens-Belden Manufacturing Company (B)**

Time-study Data Sheet

Description of Job Drilling link rod on hand-feed drill press

Element No	Element	Time hundredths of a minute										
		Cycle										*Average*
		1	2	3	4	5	6 *	7 *	8	9	10	
1	Pick up piece, place in vise and tighten	21	17	14	17	16	24	26	14	15	14	17.8
2	Drill three holes, hand-feed	40	41	40	38	39	59	56	38	38	37	42.6
3	Remove piece from vise and put aside	10	9	8	10	12	19	8	9	9	10	10.4
	Total	71	67	62	65	67	102	90	61	62	61	70.8

* During cycles 6 and 7 the operator was watching a girl from the payroll department who was talking to a machine operator across the aisle

The time-study engineer then showed the superintendent the data from a study he had made of a dissimilar operation, the drilling of link rods on a hand-feed drill press. Exhibit 2 shows this information.

The supervisor studied both data sheets and then remarked to the time-study engineer that the hourly base rate on the milling machine was $1.80 while the comparable figure for the drill-press job was $1.20. The time-study engineer replied that the piece rate on the grinding job was 5.9 cents per piece, and the piece rate on the drilling job was 1.7 cents per piece. Both rates included an allowance of 15 per cent over the average times for personal needs of the operator, interruptions, fatigue, and the like. The supervisor asked how long it would take the operator to go from the grinding machine to the drill press. The time-study man replied that the average time allowed for turning from one machine to another on jobs where one man operated two machines was 0.03 minute.

The superintendent then suggested that the time-study man prepare a time-study data sheet for one man running both the grinding and the drilling operations. He said he also would like to see a similar data sheet for one man running two grinding machines on the access plate job.

Exhibits 3 and 4 are the two data sheets as prepared for the superintendent by the time-study man.

Exhibit 3 Wilkens-Belden Manufacturing Company (B)

Time-study Summary Data Sheet—Grinding and Drilling Operations

Description of Job: One operative grinding face of access plate on surface grinder and drilling link rod on hand-feed drill press

Element No.	*Element*	*Average time, hundredths of a minute*
1	Turn to grinder	3.0
2	Remove piece from fixture and put aside	27.6
3	Pick up piece, adjust in grinder fixture, and start grinder	58.6
4	Turn to drill press	3.0
5	Pick up piece, place in vise, and tighten	17.8
6	Drill three holes, hand-feed	42.6
7	Remove piece from vise and put aside	10.4
	Time required to grind one access plate face and drill three holes in link rod	163.0

NOTE: The grinder never need be idle waiting for the operator because the time required for the drilling cycle elements is less than the grinding element time. The drill press will be idle over 50 per cent of the time. The installed cost of the drill press was $505; the installed cost of the surface grinder was $15,600.

QUESTIONS

1. What advantages over the present method of operation would you expect to result if one operator performed both the grinding and drilling jobs?

2. What difficulties would you expect would be encountered in any attempt to have these two jobs done concurrently by one operative?

Exhibit 4 Wilkens-Belden Manufacturing Company (B)

Time-study Summary Data Sheet—Grinding Operation

Description of Job: Grinding face of access plates, one operative running two surface grinders

Element No.	*Element*	*Average time, hundredths of a minute*
1	Turn to grinder 1	3.0
2	Remove piece from fixture and put aside	27.6
3	Pick up piece, adjust in fixture, and start grinder 1	58.6
4	Turn to grinder 2	3.0
5	Remove piece from fixture and put aside	27.6
6	Pick up piece, adjust in fixture, and start grinder 2	58.6
	Time required to grind two plates	178.4

NOTE: Two men operating two grinders will machine two plates in 1.692 minutes. The longer time required when one man operates two grinders results from the shorter time required for the grinding element compared to the time required to turn to a machine, unload, load, and start it.

3. Why did the superintendent want to see figures on the job if one man were to operate two surface grinders?

4. What action would you recommend with respect to the time-study man's suggestion to have the drill-press job done by the grinder operator?

6

DYNAMICS OF INDUSTRY—EXPANSION

HALMARK BATTERY CORPORATION

1. A COMPANY CONSIDERS EXPANSION OF ITS PRODUCTION CAPACITY

The Halmark Battery Corporation manufactured storage batteries for use in automobiles. It operated a modern plant with a production capacity of 2,500 batteries daily. This plant was a highly efficient operating unit and at the time of its erection was considered to be of optimum size. Management of the company foreseeing a steadily growing demand for storage batteries was considering ways and means of increasing production.

2. DYNAMIC SOCIETY

The modern business manager lives in a highly dynamic world. Perhaps his most difficult task is the maintenance of an operating flexibility that permits adjustment to ever-changing conditions. Basically the manufacturer must respond to two sets of variants: changes in market volume and market preferences; and, equally significant, technological change that may be either developmental or occasionally drastic in its impact.

Ever since the Second World War, industry in this country has operated in an environment of growth. Immediately after the war a pent-up consumer demand was responsible for a rate of industrial expansion seldom experienced. Subsequently population increase, higher wages and salaries, an ever-rising standard of living, and social legislation have brought about a steady expansion of consumer demand and a responsive increase in ability to produce. While the market has been expansive, its direction has not been continuously upward. There have been downward movements followed by recoveries. These ups and downs have varied in intensity and duration. At no time have recessions equaled in severity the more spectacular cyclical fluctuations of the prewar period. Nonetheless, the importance of maintaining production flexibility and of exercising foresight with respect to demand variability has been and will continue to be a major concern of the industrial executive.

At no time in our history has technological change been as significant as it has been during the past decade. Commonly the so-called industrial revolution of the previous century has been cited as the classic example of technological development. But in scope and in depth, technological change since the Korean War has exceeded all previous times. In almost any industry, management will point out that over 50 per cent of the products currently in production did not exist 10 years ago. Equally rapid technical change has pervaded production processes. Some of these process changes are a speeding up of earlier trends. Automation is an example of this. Industrial mechanization has been on the increase in our industry for a century. Automation is simply a rapid extension of the mechanization concept to process areas where development has been relatively slow; materials transfer and process control are typical examples.

Both product and process change have intensified because of management emphasis on research. Only recently has industry at all adequately availed itself of research as an important business resource. Today management spends great sums on this activity: pure research, applied research, product development. That research pays dividends has been amply demonstrated. But in no sense has it made life simpler or easier for responsible managers. There is reason to expect that technological change deliberately induced by research will become even more dynamic in the decade ahead.

Occasionally one hears an executive say that the only certainty in his business is that it will change. He realizes that he must manage in an environment of uncertainty. He must keep his operation growing if it is to maintain its position in industry. But flexibility, the ability to cut back when conditions indicate or to move forward quickly when the occasion warrants, is essential if successful growth over time is to be attained.

3. INFLUENCE OF THE MARKET ON THE EXPANSION PROBLEM

Increase in the output of a manufacturing concern is a many-sided problem. The degree of certainty or uncertainty of outlet is a most important consideration in determining whether or not expansion is advisable and, if it is, the method of expanding plant output to meet the estimated requirement calls for careful consideration.

Expansion of a plant being operated at one-shift capacity often entails steps which are not easy to retrace. Therefore, size and permanence of anticipated demand increase are very important. Choice of method of increasing output is greatly affected by conditions of demand. If there is reason to believe that the need for increased output is relatively permanent, expansion may take the form of extension of plant facilities through enlargement of buildings or construction of new buildings and the purchase of new equipment. Such action is long range in its effects, and the addition of one or more working shifts utilizing existing physical facilities may be deemed a more sound procedure. Particularly is this likely to be true if demand permanence is somewhat questionable. In some ways the simplest method of increasing output may be overtime work by the existing crew. This method often seems particularly attractive when there is little or no assurance of substantial, sustained increase in demand. It is the method of least permanent commitment inasmuch as it usually is easy to revert to the old rate of output.

4. EFFECT OF EXPANSION ON PRODUCTION COSTS

Expansion of output invariably affects production costs. It is a mistake to assume that increase in output will result in lower unit costs. Costs of product may be lower per unit of output or, unless care is exercised, may be higher. This effect on production costs may result from permanence or lack of permanence in the new rate of output. Even though the new rate of production is constantly maintained, the change in processing is very likely to affect costs, and the change is as likely to be an increase as a decrease in the cost of producing each unit of product turned out. Costs, then, are a most important aspect of the expansion problem. Particularly is this true of labor and burden costs.

5. BUSINESS ASPECTS OF PLANT EXPANSION

The financing of an expansion program is obviously a business problem. Questions involved in demand determination are likewise obviously of a business nature. Somewhat less apparent are the strictly business aspects of the method of getting the desired physical increase. These business considerations largely grow out of the relation of demand stability to method of operation and the effect of method of expansion on cost of the product turned out. Thus, business considerations are involved even in such technical engineering matters as determination of method of processing and selection of equipment to be employed.

This chapter deals mainly with the business aspects of the expansion problem. Some consideration of the techniques of production is inevitable, but these are dealt with as the businessman is concerned with them. Production is always a twofold problem. It involves engineering, and it involves the business utilization of engineering techniques. Certainly the business executive cannot ignore the engineering aspects of production, and production on an exclusively engineering basis does not ensure profit. The executive of an industrial enterprise may or may not be an engineer. Frequently he is essentially a financier or a man with a market and sales background. Lack of engineering training need not preclude success in this field, provided that there is understanding of the importance of sound engineering technique and ability to utilize such techniques in a business program. In no industrial management problem is this relationship of business and engineering closer than in the expansion of the successful manufacturing enterprise. To ignore the business aspect of this problem is fatal. Failure to appreciate and evaluate soundly the technical aspects of production expansion will defeat the very object of the expansion, profit increase.

6. PROBLEM OF THE HALMARK BATTERY CORPORATION

The Halmark Battery Corporation had been organized by Thomas Laboratories, Inc., to undertake the manufacture and sale of lead-acid storage batteries. The enterprise had been instigated at the request of a large-scale purchaser of batteries that the research organization of Thomas Laboratories, Inc., develop a more efficient battery at a cost comparable with costs of other batteries on the market. A large contract had been promised Thomas Laboratories, Inc., provided that an improved battery could be designed. After diligent research a battery that met the specifications of the purchaser had been developed and the contract granted.

Thomas Laboratories, Inc., was a manufacturing company controlling several subsidiaries engaged in the manufacture and sale of products bearing the company name or trade-mark. The corporation was noted for its research activities in the electrical industry and other industries. As soon as a new or improved product was developed by its principal organization, so that a fairly stable demand for a quantity suitable for economical manufacture was ensured, it was the policy of the company to organize a subsidiary company to carry on the enterprise. The Halmark Battery Corporation had been organized in accordance with this policy.

Thomas Laboratories, Inc., executives sought and managed to secure a man to plan and build the new manufacturing unit who was of an open mind and unhampered by traditions of battery manufacture, but who had an adequate background of technical and industrial experience. This new man, Mr. Demarest, as general manager was given responsibility for the determination of the size of the unit, for erecting and equipping buildings, for redesigning the product to meet manufacturing conditions; and for selecting the executives and personnel.

After a thorough study of the situation, Mr. Demarest concluded that the economical quantity of manufacture was approximately 2,500 batteries per day, and this quantity became the basis for further plans. This manufacturing quantity was determined in part by the requirements of the assembly plant maintained by the automobile manufacturer who awarded the contract previously referred to and in part by the balancing of labor and overhead costs estimated for several ranges of output that might be secured by sales outside the contract.

A site for the new plant was selected in a growing manufacturing center which attracted labor and service industries. Sufficient land was reclaimed by the filling of a marshy tract to meet the needs not only for a plant of the desired capacity but also for an expansion to four times the original capacity. Concrete buildings were erected in a manner allowing for the construction of additional buildings, either as independent units or in the original line of processing. Careful attention had also been given, prior to the construction of the plant, to the design and construction of both processing equipment and handling equipment and to their adaptation to each other.

As a result of the careful preplanning of the enterprise, the manufacture of 2,500 batteries per day was undertaken on a most efficient basis. Particularly noticeable to a visitor at the plant was the small number of men working at jobs other than direct operation or supervision of machines. This situation had resulted from a coordination of equipment for handling raw materials and work in process with the various production machines and from an analysis of jobs in order to secure an effective division of labor both between individuals and between the operative and the machine. Production was on a straight-line basis. The sequence of operations was planned so that the various groups of workmen reported for work at different hours in accordance with the process schedule. Similarly, each group finished at a different hour in the afternoon. The plant was manned and equipped for a daily production of 2,500 batteries without recourse to a night shift or overtime except for three processes. Grid casting was accomplished by three shifts working continuously during a three-day week because of the saving in gas, labor, and material losses due to drossing of the metal when melting pots were shut down and started up. Forming and charging were also continuous processes on three shifts because of the small amount of labor involved and the desire to save time in processing. Had it not been for the forming and charging operations, it would have been possible for the plant to have a complete turnover of 2,500 batteries each day, the parts passing through the various operations and emerging as completed batteries to be shipped at night.

Waste in motion, effort, time, and material was minimized. Among the achievements of the new management which were indicative of its diligence and inventiveness were the piping of molten lead to different points in the process, the designing of automatic equipment for the casting of lead parts, the "pasting" of plates by machine, the designing of new features to provide extra capacity, and the developing of devices to ensure and control the quality of production. To safeguard the worker, furthermore, since lead-battery manufacture presented hazards to health from lead poisoning, the management developed tests for applicants for jobs, maintained a medical department with a nurse in attendance, protected the workmen's street clothes from contamination by a washing process which made it impossible for an employee to avoid responsibility in this connection, provided workmen with respirators, and installed a ventilating system.

The existing plant required a force of 150 men in turning out 2,500 batteries daily.[1] The batteries were produced in various sizes, the number of plates varying from 7 to 21, and in four grades, varying as to materials and workmanship. The retail prices of the four grades in the 13-plate size were $8.95, $13.95, $17.95, and $19.95. Approximately 65 per cent of the cost of producing a battery was represented by the cost of materials, and 35 per cent by the labor and overhead.

7. BATTERY MANUFACTURE AT THE HALMARK BATTERY CORPORATION PLANT

The manufacture of a storage battery is a combination of fabrication and assembly. The parts which go to make up a storage battery are the case, the cell covers, the vent plugs, the plates, the separators, the plate straps or posts, the connectors, the sealing compounds, and the electrolyte. The Halmark Battery Corporation purchased cases, cell covers, vent plugs, and separators. Its major fabrication operations were those of manufacturing the plates (see Exhibit 1). The main operations in making the plates were grid casting, grid trimming, mixing the paste with which the grids were filled, applying the paste to the grids, grid drying, and giving the plates a forming charge.

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[1] The plant of a well-known Middle Western battery company had a daily capacity of 15,000 batteries. Production at this volume required a force of approximately one thousand men. The Toronto and Los Angeles plants of the same company had capacities of 1,000 and 2,000 batteries per day.

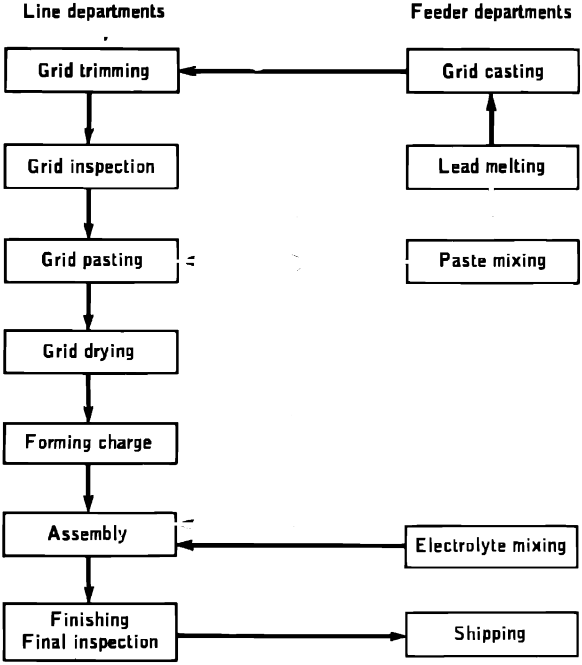

Exhibit 1. Halmark Battery Corporation. Process Diagram.

The grid or framework of latticelike construction was cast from a lead alloy in molds. At the Halmark plant, standardization of design and perfection of equipment made it possible to cast grids for both positive and negative plates for all sizes of the battery by mechanical means. The equipment automatically controlled the temperature of the metal which was mechanically poured into molds resembling waffle irons. The castings were automatically cooled, removed, and conveyed to a trimming and inspection station. Two men supervised three casting machines.

After being cast, grids were trimmed and inspected by examination for broken bars, cracked lugs, and other imperfections. Defective grids were remelted and recast. Perfect grids passed on to the pasting operation.

The mixing of the paste that constituted the active material was done by machine. Cranks of peculiar shape, revolving in opposite directions within a drum, mixed thoroughly the various components that made up the paste. Scientific control through rigid adherence to formulas and constant testing of materials made possible the best of active materials in well-conditioned pastes, both positive and negative. The mixing machines were located on a mezzanine directly above the pasting machines. Materials used in making the paste were conveyed in drums to bins and thence to the mixing machines. Mixed paste flowed by gravity to the pasting machines on the floor beneath them.

The pasting of the grids was done by machine. The principle of the machine operation was quite similar to the hand method employed in some shops. The puttylike active material was spread over the grid and worked thoroughly between the latticed members. The paste was compacted into the grids by mechanical means so regulated as to produce uniform plates by subjecting each area to the same pressure. As the life of a storage battery is partly contingent upon the conductivity ensured by a proper bond between the active material and the grid, it was essential that the pasting operation be performed in an efficient manner. The pasting equipment formed a part of the production line. Grids passed on rolls to the pasting machines, which were automatically supplied with paste from the paste-mixing machines above. Pasted grids were mechanically discharged onto power-driven conveyors.

After being pasted, plates were dried. In the open air, drying is a matter of one to three days. At the Halmark plant, specially constructed ovens were used which reduced the time required for drying to a few hours.

The dried plates were given an initial charge (forming charge) for converting the paste of the positive plates into lead peroxide (PbO_2) and that of the negative plates into sponge lead (Pb). To give the forming charge, plates were hung on racks in lead or lead-lined wooden forming tanks containing electrolyte of a definite composition, all plates being connected to a common bus. A suitable number of tanks were then connected in series, and the line was connected to the corresponding busses from the generator which supplied the forming current. In forming the positive and negative plates, various charging rates and time cycles in regulation of current were used, depending on the size of the plate. There were also controlled variations in the density of the electrolyte. By virtue of standardized materials and usage, the forming charge at the Halmark plant was subject to close scientific control by an operative in a glass-enclosed room with instruments to keep him informed of the progress of all units. The forming process had been reduced to 30 hours.

Upon completion of the forming charge, the plates were drained and then burned into groups. This was accomplished by setting up the single plates in fixtures and welding their lugs to posts by means of torches. As a result of this operation the so-called "groups" were obtained, consisting of a definite number of positive or negative plates joined to a plate strap (or post) and so spaced that they could be meshed or leaved together with a corresponding group of opposite polarity with separators inserted between the opposing plates. Such a pair of groups with the inserted separators composed an "element," the unit placed in each cell of a battery being assembled. An element having been placed in each cell of a given battery, the cell covers were slipped over the posts, a sealing compound was poured in the space between the covers and the cell walls, and connectors were burned on in such a way that the cells were connected in series. The assembled battery, after being subjected to various inspections, was filled with electrolyte of the proper strength and was given an additional charge known as the "conditioning" charge. At the Halmark plant, the assembly took place on a series of roller conveyors by which the battery passed from one station to the next, each worker performing one of the several necessary operations. Capacity production required nine workers on the assembly line. The oxyacetylene flame for burning on connectors was turned off and on by an automatic switch as each unit passed down the line.

The finishing operations consisted of smoothing out irregularities in the assembled unit, marking terminal posts, painting on trade-marks, placing vent plugs in the filling holes of the cell covers, and various inspection operations, including a final inspection just prior to packing for shipment.

B. POSSIBLE METHODS OF INCREASING HALMARK BATTERY CORPORATION OUTPUT

When the Halmark Battery Corporation had been in operation for three years, the executives of the company foresaw an opportunity to increase the demand for its batteries. Increased output, they believed, could be obtained through an extension of the sales made to outlets other than those resulting from the original contract. It was quite possible that total production might need to be increased from

2,500 to 5,000 batteries per day. Company executives considered and investigated several methods of increasing output. Night-shift operation of the existing unit was obviously worthy of consideration. The management was firm in its belief in the efficiency of the existing unit. This suggested as an alternative setting up a second complete unit duplicating the present one. If this was done, two courses would be possible: (1) increase in the size of the present plant to accommodate the new unit or (2) construction of a separate building to house the second unit. Another method of expansion would be extension of the present line by the installation of machines of larger capacity, or by duplicates of present machines used in the various operations throughout the process. Still other methods of increasing output were possible.

9. ADVANTAGES AND DISADVANTAGES OF A NIGHT SHIFT

Seemingly, a second shift would be the easiest and simplest method of increasing output. By operating the lead-melting and grid-casting units continuously, investment in new facilities could be limited to additional equipment for forming charges, which would consist of more tanks with their control devices. The result would be more intensive use of existing equipment, which would tend to reduce unit burden costs both for present output and for the added volume. While burden costs in battery manufacture were commonly much less than raw materials costs, nevertheless they represented a substantial element in cost of production, and the effect of any expansion proposal on burden costs was an important consideration of Halmark executives. The more intensive use of equipment would tend to reduce risks of equipment obsolescence. As the lead-acid storage battery and its production process were well past the stage of rapid development, these obsolescence risks would probably be of less importance than if the product and its manufacture were newer.

The greatest disadvantage of a second shift was thought to be difficulty in obtaining suitable labor. Night operation was not common in the locality, and transportation would be inconvenient for the men. Certainly a higher hourly wage would have to be paid than was necessary for the day shift, and even then it was likely that spoilage would be increased. It could be argued that mechanized production of this type calls for little skilled labor and that unskilled labor probably could be found and trained. It might also be pointed out that, like burden, labor costs were not a large percentage of total costs. This would tend to minimize the importance of higher wage rates. Some difficulty might well be expected in providing good supervision. While it is true that supervision would be less difficult than in some industries, protection of the company's reputation for high quality without greatly increasing spoilage would call for efficient supervision. This probably would entail transfer and promotion from the day shift.

It is unlikely that the installation of a second shift would result in lower unit production costs for this business. Depreciation and obsolescence costs would be lower, but labor and supervision costs would be higher. The net effect on unit costs probably would be an increase rather than a decrease.

The most attractive feature of the plan is its responsiveness to volume change. Should the increase in demand prove temporary, it would be possible to return to one-shift operation without greatly increasing operating costs. Nightworkers could be laid off, and there would be little idle equipment as a result of output curtailment. Also, if the increased demand should prove to be fluctuating on a seasonal or other basis, the extra-shift method probably is best suited as to flexibility.

10. ADVANTAGES AND DISADVANTAGES OF DUPLICATING THE EXISTING UNIT

Company executives were convinced of the low-cost operating efficiency of the 2,500-batteries-per-day unit. The advent of 12-volt automobile electrical systems had necessitated no major changes in the original setup of the plant. A 12-volt battery had more cells than the 6-volt battery. The company's plant engineers had been able to make the necessary changes in assembly operations without disrupting the existing process flow. The major effect of producing both 6- and 12-volt batteries had been an increase in finished product inventories to avoid too frequent changes in the assembly process.

The demonstrated efficiency of the 2,500-batteries-per-day unit suggests the desirability of expanding by building a second unit, a duplicate of the existing one. Such a plant would incur none of the developmental costs incurred when the first plant was built. Furthermore, experience with a similar unit would make it possible to avoid much of the lack of smoothness which is usually costly when a new plant goes into operation. Finally, the costs of operation would be known in advance.

If a duplicate plant was erected, it would be operated as a separate unit on its own orders and under the control of its own executive personnel. Results of operation would be subject to check against those of the older plant, and the competitive situation thus developed might well prove a valuable continuing incentive throughout the organization from top to bottom. A second complete unit would avoid most of the objections to a night shift. It would have no disturbing effect on existing operations, and results would be accurately predictable.

The building of a separate 2,500-batteries-per-day unit is obviously a long-time commitment, possessing little flexibility to meet volume change. It is true that any fluctuation in the added volume would have no effect upon the operation efficiency and production cost of the present unit. This does not mean, of course, that the profits of the business as a whole would not suffer if the new unit was idle. This lack of flexibility is the most obvious objection to the building of a duplicate unit. The plan calls for the same sort of demand assurance that was requisite to the construction of the original plant.

11. EXPANSION OF PRESENT PRODUCTION LINES

The chief argument in favor of a separate duplicate of the present unit is the proved efficiency of the 2,500-batteries-per-day unit. At the time the existing plant was constructed, a unit of this size was judged to be of optimum size. As the management still holds that opinion, it would seem that increasing capacity of the various parts of the existing plant would be undesirable. It would tend to upset existing operating efficiency and increase production cost. Operation might well be so inflexible as to affect adversely costs of all batteries produced if volume of output was substantially below capacity.

There is another aspect of this situation, however, which is probably of major concern. When the size of the existing unit was determined, two types of influences dictated, market demand and technique of production. If the demand situation has changed substantially, this alone might call for a departure from 2,500 batteries per day as the optimum output. Also, it is unlikely, even in so simple a process as the one involved, that optimum size for each and every operation would be the same.

It can be readily demonstrated in this case that optimum size of the process as a whole was the result of compromise as to capacity of the various operations making up the complete process. Although the plant as a whole operated six days a week, the lead-melting and grid-casting operations were carried on only one-half of that time, three days a week. This means that insofar as these two operations are concerned, a process capacity of 5,000 batteries per day is more nearly optimum as to technique of operation and production cost than is a capacity of half that output. This does not mean that the capacity of the lead-melting and grid-casting equipment installed is excessive. Nor does it mean that the process as a whole has submaximum efficiency. It only demonstrates that inevitably optimum capacity of a plant as a whole does not mean that each step in the process will be carried on at optimum rate of operation.

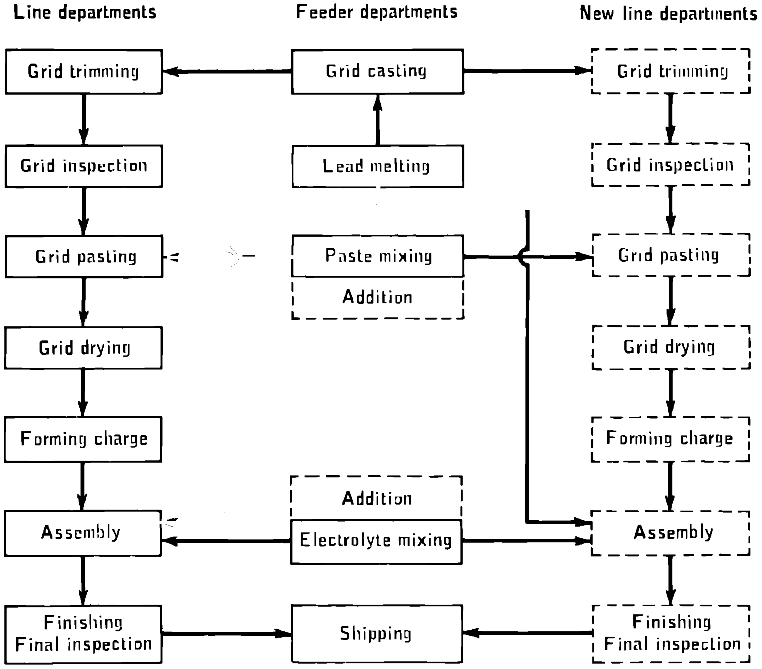

Exhibit 2. Halmark Battery Corporation. Diagram to Show Proposed Changes in Process.

This situation is of considerable importance in determining a method of expanding plant facilities of the Halmark Battery Corporation. There is substantial argument in favor of increasing output by means of a combination of duplication of certain steps in the process, increasing the capacity of some steps without duplication, and utilization of the excess capacity that already exists in certain operations as now carried on. The diagram in Exhibit 2 is indicative of the possibilities of processing economies inherent in this method of securing increased capacity.

In the diagram no additional facilities for lead melting and grid casting are indicated. It is proposed to operate existing equipment six days a week instead of three. The result would be a unit cost for these operations less than the existing cost. This reduction would be effective for both the new volume and the present output. Variation in output would affect these costs but would never increase them above unit costs prior to expansion, and would tend to decrease existing costs to the extent that output is in excess of the 2,500-batteries-per-day level. This proposal seems to be the most likely method of treatment for lead melting and grid casting.

The equipment for mixing paste and electrolyte might well be displaced with equipment of greater capacity. The nature of these operations indicates this procedure in the interest of lower labor costs. Careful study of the operations and equipment involved might indicate that the installation of additional equipment similar to that already in use would be preferable. However, it is probable that investigation would show that costs of operating these departments would be less per battery if new, larger equipment units were installed. This would be likely to hold true even though output were substantially less than 5,000 units per day.

The situation is the same in the final inspection and shipping departments. It is probably more economical to expand these departments than to duplicate them. Quality standards should be more uniform in a single inspection department, and shipping costs should be substantially less than if two complete shipping organizations handling the same products were maintained.

The nature of the other operations of the process indicates that these steps are now carried on at an optimum rate. If this is true, these units should not be disturbed, and greatest efficiency at maximum and submaximum rates of operation could be obtained by setting up separate duplicates of the existing units. Operating costs at capacity output would probably be close to present unit costs for these operations. Output at less than 2,500 product units per day would be less disturbing than if other methods of expansion were employed. As long as output was up to 2,500 batteries per day, one line could be operated at optimum efficiency, and only unit costs in excess of 2,500 batteries and less than 5,000 batteries would be adversely affected. Furthermore, this adverse effect probably would be less than if equipment of greater capacity was designed or than if duplicate units were installed in a single line of operation.

The foregoing indicates the character of investigation undertaken by Halmark executives and engineers in searching for a sound solution to the problem posed by the expansion proposal. Before final decision was reached a heavy cutback of production schedules of all the large automobile manufacturers occurred. It had been the experience of the Halmark Battery Corporation that any substantial reduction in new-car sales was accompanied by an increase in demand for replacement batteries. In the past this increase in replacement demand always had lagged behind the new-car sales reduction. By model-year end, however, Halmark total sales for the year had been affected but little, if at all. Because of the temporary falling off in total battery demand and uncertainties within the new-car industry in general, Halmark executives decided that for the time being they would take no action on the expansion proposal. All data with respect to plant expansion were filed carefully with the expectation that they would be useful at a future time.

It was two years before expansion again was discussed actively by Halmark executives. In reviewing the results of the earlier investigations, the only new element in the situation seemed to be the probable future popularity of 12-volt batteries. When it finally was decided to go ahead with an expansion program, the layout shown in Exhibit 2 was adopted. The new assembly department was to be equipped with emphasis on 12-volt systems but easily adaptable to 6-volt output. It was anticipated that 6-volt output would be predominant for some time but that eventually by concentrating all 12-volt production in the new facility the need for occasional inventory build-up would be eliminated.

12. SUMMARY AND CONCLUSIONS

The case of the Halmark Battery Corporation is an excellent illustration of the management problems involved in increasing the output of a manufacturing business. These problems are essentially of two types: engineering and business. The engineering problems have to do with changes in methods of processing and design and installation of the equipment involved. The business problems have to do with market demand for the product and cost of production as affected by variation in market demand and change in method of production. The engineering and business aspects of expansion are so interrelated as to be practically incapable of isolation. Neither is more critical than the other. Neither will alone provide a solution. The important principle is that neither should be neglected.

Methods of Expansion—Overtime Work. The common methods of securing increase in output are overtime work, night shifts, and increase in physical production facilities. Overtime work is best suited for temporary increases of short duration. Short seasonal peak requirements are typical. Usually no increased permanent investment is involved, and return to normal rates of operation is thus relatively easy. The existing work force is not expanded, and no costs of hiring and training operatives and supervisory personnel are involved. However, overtime work can never be more than a means of satisfying temporary, short-lived increases in demand. Hourly wage rates or base rates are usually 50 per cent greater for overtime work. Men cannot efficiently work long hours for any protracted period of time. Modern efficient operation calls for speed on the part of operatives that precludes this. Overtime work runs up labor cost, increases spoilage, and tends to increase costs of supervision. Its most desirable attribute is its flexibility. Its outstanding limitations are its costs and its temporary nature.

Night Shifts. Recently, short hours for men and long hours for machines has become almost a battle cry in industry. The intensive use of equipment is often very attractive from a business standpoint. This is true especially in businesses which have a large proportion of equipment burden costs in the total cost make-up. In industries where product, methods, or machines are in process of rapid development, night operation frequently is an excellent means of forestalling the high costs of equipment obsolescence. Even when the product and process have attained a rather stable state, intensive use of the equipment aids materially in lessening the risk inherent in the long-time capital commitments of highly mechanized industry. Machines cannot distinguish between day and night, and machine efficiency usually is just as high after sunset as it is during the daylight hours.

Nightwork for men is of more questionable desirability. It is a matter concerning which there are "schools of thought." Undoubtedly, nightwork is commonly somewhat more costly than daytime labor. While this is not always true, there is a tendency for night hourly wages to be somewhat higher than daytime wages. If there is a difference in labor efficiency between day and night shifts, the margin is in favor of the day shift. Commonly, men would rather work a day shift than a night shift.

This does not mean that night shifts are undesirable. First, the machine cost savings frequently much more than offset the higher labor costs. Furthermore, in some industrial communities, night operation of mills is common to the extent that there is little or no wage differential between day and night shifts. Many manufacturers are today demonstrating that with proper supervision night labor can be just as efficient as day labor in many industries. It has frequently been proved that, given favorable conditions, spoilage by the night shift need be no greater than that by the day shift. In certain locations, night atmospheric conditions are actually superior and more conducive to efficient processing. Continuous operation often tends to reduce cost per unit of power used in processing, particularly when power is purchased. Not all men object to working on night shifts. Occasionally workers actually prefer night-shift work, either because of higher wages received or because of greater freedom during daylight hours. From the labor standpoint, practically the only generalization that can be laid down with regard to nightwork is that there is a definite tendency for it to be less satisfactory and to compare less favorably with daywork than is the case with machine costs.

Among people with extensive operating experience there is rather common belief that many of the undesirable results of night-shift operation come from inadequate supervision. All the difficulties in the way of getting good returns from a night shift seem to emphasize the importance of able supervision. If there is a difference in the need of supervision as between day and night shifts, it would seem that the latter has more and varied requirements. The supervisor or foreman on the night shift usually has to depend solely on himself. He does not have the help and backing of all the varied functional assistance that is regularly available on the day shift. Unfortunately for the night shift, it is usually the day shift that has first call on the supervision facilities of a company. The night shift takes what is left and gets second best, or the less experienced. The result is exactly what one would expect. Although good supervision alone will not ensure the success of a second-shift operation, it is an important requisite if a night shift is to be successful.

The social desirability of nightwork is a debated issue. Some states prohibit nightwork for women in certain industries. Some authorities urge that men do not like nightwork and that it results in undesirable social conditions. The answer in a given case seems to depend on the community. If night operation of plants is common in the vicinity, the social effect of any one plant's adding a night shift is quite different from what it would be if the life of the community were not adjusted to a considerable amount of nightwork. While the absence or prevalence of nightwork in a community is no index of the general social level of the community, it is an important factor in the building up of a suitable night labor supply.

The major advantages of the night shift as a means of increasing plant output are its tendency to reduce physical investment risks and costs and its responsiveness to demand fluctuation. In this latter regard, it is more rigid than overtime work. Increase in output on this basis entails the building up of the work force with its attendant costs of hiring and training. Overtime work avoids these costs. Discontinuance of a night shift is a much more serious decision than is discontinuance of overtime work. Nevertheless, the night shift is flexible as to capital commitment.

The outstanding disadvantages of the night-shift method have to do with personnel. Labor supply is not always available or of the best. Wages may be higher for nightwork. Transportation may be difficult. Workers may be less efficient. Good supervision may be difficult to attract. Quality of output may suffer.

Obviously there is no one answer to the night-shift problem. The nature of the product and the process, the quantity and characteristics of the labor required, site and location—these things, and others, vary as between cases. Thus the answer must be based upon the particular situation with due regard for both the business itself and the environment in which it operates.

Plant Expansion. Commonly, where overtime work and night shifts are weak, expansion of physical facilities is the strong method of increasing output. Conversely, plant expansion is likely to be weak where long hours of operation of existing facilities are strong. Plant expansion is likely to be advantageous on the labor side; its most frequent weakness is in its permanence of capital commitment and inflexibility in changing conditions.

These generalizations do not always hold. There are times when very large capital expenditures tend to discourage competition. Particularly is this true when the utilization of machines and equipment of greater capacity tend to reduce operating costs. All too frequently this expectation is overdone. Many gigantic producing units exist today that have failed to live up to expectations of low unit producing costs. The economies of size are much less than is commonly thought. In many processes, the point of balanced returns is reached rather early in the expansion process. Much ill-advised financial promotion fails on this account.

When physical plant facilities are increased, the method of expansion is just as important as the question whether to expand or not to expand which preceded it. This is demonstrated in the Halmark Battery Corporation case. Engineering skills and techniques pervade this problem, but as we have already seen, the business aspects of the situation are of equal importance.

Probably all too little attention has been given the idea of optimum size of the producing unit. When management has this concept under consideration, it should always be remembered that even this is subject to the influences of change. Undoubtedly, certain businesses have characteristic size optimums, large units conclusively more efficient than small, or small units possessing all or most of the advantages of large units and at the same time escaping many of the difficulties of large-unit administration. But within these limits, change in production technique or market characteristics may drastically alter the output level at which production is most economically attained. Also, the limit characteristics themselves are not permanently fixed. Extension of labor organization activities seems already to be making for a tendency toward smaller decentralized producing units in some industries. Also, technical production changes do occasionally result in production economies for small units which bring them up into the class of relatively low-cost producers.

Job shop machine shops characteristically have remained small. Each job such a shop undertakes differs from other jobs in process in the shop. To a considerable extent the profitability of these small shops has been dependent upon the ability of their managers to quote prices consistent with the costs of doing the jobs and, then, to schedule the constantly changing variety of work in the shop in such a way as to keep the shop's general-purpose equipment fully occupied. As the amount of work undertaken in one of these shops grows, the difficulties of effective scheduling increase. As a result, these shops characteristically have remained small. Their managers have learned that it does not pay to expand beyond some certain point. They have been an example of operating control as the limiting factor on size.

Recently mathematical procedures and applications have been developed which make possible quick and inexpensive scheduling of widely varied production over a relatively large number of machines. This removes the scheduling restriction which has kept machine shops catering to job shop work small. The relatively near future is sure to see increase in the size of what heretofore has been optimum size of unit in this business.

Much the same sort of change is likely to be observable in the case of job print shops in communities of sufficient size to support large shops of this type. In the past control problems have tended to keep these shops small although there have been a very few exceptions to this practice. Low-cost processing of large amounts of data will change this, and growth in size of the more aggressive job printing establishments is to be expected. Let the small print shop take careful note of this, for unless its management does recognize this development and does something about it, its competitors can make survival questionable.

Change in the technology of operating control has had, and will continue to have, a decisive influence on optimum operating size of certain business units.

Optimum size of producing unit is a worthwhile management goal. It should be remembered, however, that optimum size changes, that the dynamic characteristics of industrial society have their impact here as elsewhere, and that today's optimum may be obsolete tomorrow. A management to succeed must be forward-looking in the areas of market demand and production technique if its control of size of producing unit is to be most efficient. As a corollary, it is a mistake to believe that because a clever management has brought into existence a plant of size such that operating costs are at a minimum, increase in output beyond the capacity of that unit will of necessity be a matter of simple duplication. The situation of the Halmark Battery Corporation is a case in point.

Increase in demand for a product already in production is not the only condition which may initiate consideration of production expansion. As we shall see when we come to consider the selection and layout of production equipment, obsolescence of existing production facilities may well raise this issue. Occasionally, inefficiencies of marketing at an existing production level may bring expansion or contraction of production facilities into consideration. Market demand for variety in output also often brings the question up for discussion. Under the latter condition, the problem may become acute, as the desires of the production group may well be in conflict with the aims of the production executives.

Effects of General Economic and Social Change on Current Problems of Expansion. Immediately following the cessation of the Second World War hostilities, industry set about the reconversion of its facilities for the production of peacetime consumables. This change-over was accompanied by an unusual expansion of industrial production capacity. Billions of dollars were spent for new plants and new equipment. Two major motives were behind this activity: (1) accumulated technological improvements called for replacement of existing equipment if a producing unit again was to become competitive in its field, and (2) for two decades production capacity had not kept pace with growth of population. These conditions were basic long-run influences; they were obvious and were powerful spurs to the industrial expansion that followed the war.

Perhaps more immediate influences were such factors as the tremendous unsatisfied demand for all kinds of manufactured products that had accumulated during the war, the foreseeable demand for American goods abroad during the years of foreign reconstruction, population increase, and the rapid rise in wages. The first two of these considerations were clearly of temporary duration. The future level of wages was less readily determinable. The great increase in wage rates, particularly for the large numbers of unskilled and semiskilled industrial workers, brought about a shift in cost balance at many points. With high wages, it was frequently desirable to mechanize an operation that had been more cheaply done by hand. Automatic machines could produce more cheaply with wages up than could semiautomatic machines. In many instances semiautomatic machines replaced manually operated machines.

Periods of rapid wage rise have usually been followed by periods of wage recession. Seldom have wages been reduced in these periods to the point from which they started. In the postwar period there was unusually strong reason to believe that wages never again would return to anything like prewar levels. The war period and the postwar years saw great growth in size and strength of labor organizations. Many industrialists believed that these huge powerful unions of national scope would successfully resist any reduction in wages. In this belief they have been correct. Wages have increased, even in periods of recession. Thus the risks of large capital expenditures for increased mechanization have been less than the risks of loss of competitive position that might result from failure to mechanize.

Many industrial concerns entered the reconversion period with substantial accumulations of financial resources that made expansion possible. On the other hand, costs of new equipment rose rapidly following the war and the cost of new plant construction more than doubled. These latter adverse influences caused substantial hesitation on the part of management, but the net balance of the many factors involved was a very substantial increase in industrial capacity brought about by expansion of plant and facilities.

The Korean War and the accompanying military preparedness program gave tremendous added impetus to plant expansion. To a greater extent than ever before, the industrial demands of the military were superimposed on the demands of a most prosperous civilian economy. This has necessitated an added upsurge in the expansion of plant facilities. Federal tax provisions have favored this in many instances. Also a conviction that the costs of new construction and new and superior equipment will be no less in the future has served as a spur to a high rate of capital expenditure. The current and potential industrial capacity of this nation still is untested.

Insofar as industry is concerned, the forces of social and economic change are irresistible. The decades of the 1940's and the 1950's saw such changes occurring at an unprecedented rate. There was little that a manufacturer could do but shiver and take the plunge into a stream of developments, the temperature or depth of which could be but little known.

QUESTIONS

1. Why should the modern business unit possess flexibility?
2. What are some of the conditions which may cause consideration of the expansion of the output of a plant?
3. What are the common methods of increasing the output of a plant which is operating at one-shift capacity?
4. What are the elements of strength and weakness of each method?
5. Under what conditions is each method most likely to be successful?
6. Why is supervision so important to the success of night-shift operation?
7. What is meant by the term "optimum-size unit"?
8. When a management has achieved a producing unit of optimum size, what is the nature of its problem of rate of output?
9. What is the best way of meeting this problem?
10. In your opinion, what was the best method of increasing output for the Halmark Battery Corporation? Explain fully.
11. Should the management of the Halmark Battery Corporation have come to a conclusion as to whether or not to expand output without previously reaching a decision as to the method of production increase to be employed if expansion was undertaken?
12. What is the contribution of the mechanical engineer in reaching conclusions on expansion problems?
13. Will engineering considerations provide a satisfactory solution to an expansion problem? Why?
14. What were the causes of the industrial expansion that has taken place following the Second World War?
15. Why should we expect job machine shops and job printing plants to become larger? In what other industrial operations should we expect to observe similar happenings?

PROBLEM 13 MANCHESTER TOY COMPANY

The plant of the Manchester Toy Company was operating at less than capacity, and company executives believed that as a result production costs were relatively high. An increase in output would entail increased selling expense, which it was expected would increase more rapidly than the volume. The management was not sure whether or not decreases in production cost resulting from the greater volume would more than offset the increase in selling expense necessary to market the additional output.

Sales of the company in its principal line, which comprised about 98 per cent of its business, were $237,820 for the year. On this portion of the sales it made a net profit of $11,385. Productive materials amounted to $102,102; direct labor, $44,275; indirect labor and all other overhead, $63,250; and selling expense, $16,808.

Plant capacity was sufficient to permit an increase in sales volume of one-third. Additional working capital would be needed to finance any increase in operation and was available at 4 per cent. New markets would have to be solicited, and these could be reached only with an increase in the percentage of selling expense to total sales.

It was expected that if sales increased, the cost of materials and direct labor would rise in proportion to the increase of output. Of the indirect-labor item and all other overhead, it was estimated that $18,975 was fixed and would not increase or decrease with volume. The balance of the item, however, was variable but would increase only one-half as fast as the volume. Selling expense for the extra volume was expected to be not less than 15 per cent of the amount of the increase in sales and might be even greater. Working capital necessary to finance the new volume was expected to have a turnover of twice a year.

QUESTIONS

1. Will it pay the Manchester Toy Company to increase its sales volume sufficiently to bring its plant up to capacity operation if the increase can be obtained with a 15 per cent cost of selling the increased output?

2. What is the maximum amount of sales cost for the added one-third volume that can be incurred without reducing the 4.78 per cent profit rate being made on the current volume of output?

PROBLEM 14 H. L. DANSEC COMPANY

The H. L. Dansec Company, which manufactured heavy mechanical goods that were sold through mill supply houses to industrial plants, received a large order from the State of New York for fire hose. In order to produce this merchandise in the interval before the specified delivery date, it was necessary to change operations in the fire hose department from a one-shift to a two-shift basis and to take on a number of new and unskilled operatives.

The fire hose department of the H. L. Dansec Company was one of the company's smaller departments. It was fully equipped to perform all the operations required to produce fire hose. Four rather dissimilar types of operations were required. The production of metal couplings was essentially a machining process requiring turret lathes, drill presses, and crimping presses. With the exception of two machine setters, only semiskilled machine operators were required for this work. The impregnated fabric hose tubing was made on specially designed semiautomatic machines. Unskilled and semiskilled machine tenders were employed on these machines. Assembly of couplings to hose sections was performed by semiskilled employees trained for this work. Testing and preparation for shipping required workers with only a modest amount of experience on this job. The character of the work in the department was such that the men worked individually, rarely changed jobs, and were paid on an incentive basis.

The New York contract would take a year or longer for its completion. Deliveries would be made at two-week intervals. The sales manager of the mill supply house that had obtained this contract believed that there were excellent prospects of obtaining additional contracts from the state if the conditions of the first contract were carefully met.

The production manager of the H. L. Dansec Company recognized that the addition of a second shift would cause a temporary reduction in the output per employee, which in turn would affect the compensation of the foreman of the fire hose department, since he was paid a salary plus a bonus when the average performance of the group of men under him rose above a specified standard. The production manager knew that the foreman's bonus earnings which had been averaging about one-sixth of his salary, if computed on the usual basis, would be eliminated entirely or reduced substantially for the first six weeks of the two-shift operation. During this period, however, the foreman would be working harder than usual. The production manager had authority to adjust the methods of compensation of the foremen under him if the ordinary routines of their departmental operations were disturbed substantially. Since such disturbances, however, had been infrequent, he studied each case individually before reaching a decision. The question of compensation of the foreman of the fire hose department during the period of two-shift operation fell into the category of cases requiring individual treatment. It was necessary, therefore, as a matter of policy, for the production manager to decide whether the foreman's bonus should be guaranteed at the level of his previous earnings, whether during the training period his pay should be predicated, as in the past, on the actual performance of his department, or how he should be paid.

Wages of employees in the fire hose department and of all other manufacturing departments of the H. L. Dansec Company were based on a point system. Under this system workers were guaranteed a base salary regardless of their output. The average amount of work which a normal worker of average skill, strength, and with reasonable effort could be expected to accomplish in one minute was called a point. A normal hour's work consisted of 60 points, and workers were paid a weekly bonus for performance above this rate. The same applied to the supervisory force, including foreman, who received a bonus of one-sixtieth of their base salary weekly for each point by which workers in their department averaged better than the standard rate of 60 points per hour.

The fire hose department, which normally employed about 50 workers, had been operating at an average rate of 70 points per hour so that the foreman's bonus amounted to approximately 16⅔ per cent of his base salary. The standards engineer employed by the H. L. Dansec Company estimated that the average performance of the fire hose department during the first two weeks it would be operating under the two-shift basis with approximately 50 new employees would be only about 50 points per hour, that it would be approximately four weeks before the average would be raised to 60 points per hour, and perhaps six weeks before the average would reach its former level of 70 points per hour.

Although the foreman of the fire hose department would be able to delegate the actual supervision of the second shift to his assistant, he would be held responsible for the performance of both shifts. Furthermore, during the period of training the new workers it was expected that he would do considerable nightwork in addition to his usual daywork in order to make sure that the night shift was functioning properly.

Dansec Company foremen expected that during periods of peak production they might have to work harder than at other times of the year; consequently, they accepted occasional nightwork as a matter of course. They also expected to have to train some new employees each year. When a new employee was taken on to replace a worker who was leaving, departmental point averages were affected somewhat, but since foremen anticipated that such fluctuations would take place occasionally, they did not expect to be recompensed for temporary reductions in their bonus earnings caused by replacement of personnel. The production manager, however, was undecided as to whether changing to a two-shift basis as well as taking on a large number of new employees would be judged by the foreman of the fire hose department to be a situation similar to that involving the training of occasional new workers.

QUESTIONS

1. How would the 50 new workers be trained:
   a. Assign all 50 new workers to the night shift and assign experienced workers from the day shift to do the training?
   b. Assign 25 new workers to each shift, transfer 25 workers from the day shift to the night shift, and have experienced workers on both shifts train the new workers?
   c. Assign 40 new workers to the night shift and transfer 10 experienced workers from the day shift to train new workers on the night shift with 10 new workers to be trained on the day shift?
2. How should the experienced workers assigned to do training be paid?
3. How should the department foreman be paid:
   a. During the training period?
   b. Subsequent to the training period?

PROBLEM 15 GULL ISLAND FISHERIES COMPANY

The new manager of the Gull Island Fisheries Company wished to expand the company's production. For years the company had processed and sold fresh fish, slow-frozen fish, and cured fish. To meet the developing demand for fish fillets and to exploit the Middle West as a market for fish, the new general manager installed a quick-freezing unit and began filleting a large portion of the company's output. Filleting increased waste until it approximated 55 per cent of the total weight of the fish. He wished to add to the company's products fish flakes, fish meal, glue, isinglass, and cod-liver oil.[2] He believed that this diversification of the company's products would decrease waste and make the company more profitable than at any time in the past.

The banking firm, Kendall and Thompson, held in its portfolio $60,000 in notes of the Gull Island Fisheries Company. A substantial portion of this amount was overdue, and the company was asking for the extension of additional credit. The bank's credit department had in its files financial and operating statements of the company covering a period of five years. Upon failure of the company to meet its obligations, the usual credit investigations were made, and the credit manager spent considerable time in endeavoring to determine what action the bank should take.

Kendall and Thompson had obtained the Gull Island Fisheries Company account five years earlier at the time Mr. W. K. Williams had acquired control of the Gull Island Fisheries Company and had become its president and general manager. Mr. Williams had known executives of Kendall and Thompson for many years and had done considerable business with that institution. The bank had great confidence in Mr. Williams and was glad to get the account of the Gull Island Fisheries Company. Under Mr. Williams's management the company prospered, and the bank found the account very profitable. The bank advanced funds to supply periodic current needs of the company. These loans rarely had exceeded $50,000 at one time. They always had been paid promptly, and the bank considered the company an excellent credit risk.

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[2] See Appendixes A, B, C, and D, pp. 169, 170, 171, for descriptions of these processes.

Mr. Williams had operated the business for two years when he was fatally injured in an automobile accident. The management of the business was then taken over by its treasurer, Mr. Perry, a young man who had been brought into the organization by Mr. Williams. During the first year of Mr. Perry's management the business of the company declined somewhat, but to a much less extent than the decrease in volume experienced by the business of the country as a whole. Profits shrank to a greater extent than did business volume, and in the last quarter of the year the company experienced a loss, although the last three months of the year were normally the season of greatest profit. During the early months of the following year, bank borrowings increased and in April of that year the treasurer of the company asked for extension of time on $20,000 of notes then maturing. In view of the operating record of the company and its seemingly sound basic financial condition, as exhibited in its January 1 financial statement, the extension was granted. The credit manager of the bank had the records concerning the company transferred to a file in his personal office in which were segregated those accounts which he deemed should receive his constant attention.

By midyear, payment of the major portion of the Gull Island Fisheries Company notes held by the bank was in arrears, and the company was asking for credit in addition to the $60,000 already extended. Though small, the credit department of Kendall and Thompson was efficient and exceedingly well managed. The volume of business did not permit the maintenance of a staff adequate for the making of an investigation such as the credit manager now believed advisable in the case of the Gull Island Fisheries Company. The treasurer of that company had explained his present situation as growing out of changes in the fish-packing business. He stated that if the bank would give him additional financial assistance, the business would become more profitable than ever before. The market was demanding fish fillets rather than whole dressed fish. The company had recently installed facilities which would provide for quick freezing, and the management wished to acquire equipment which would make possible the utilization of the increased waste which resulted from the filleting process. The company's treasurer believed that if this were done the business would not only regain its old profit-making ability but would become a better paying proposition than at any time in the past.

The bank's credit manager was satisfied with the ability of his department to pass on the usual credit problems that came before it. However, he was not familiar with conditions in the fish industry nor with the operating and management problems of the Gull Island Fisheries Company. The death of Mr. W. K. Williams further complicated the situation. The credit manager believed that it would be impossible for him to make a satisfactory analysis of the company's situation from its financial and operating statements without an understanding of the situation in the industry and the operating problems of the Gull Island Fisheries Company. Accordingly an experienced industrial research man was employed who, after making a comprehensive study, reported his findings as to the fish-packing industry with particular reference to operating conditions within the Gull Island Fisheries Company. The following information extracted from his report provided the basis for his recommendation to the credit manager of Kendall and Thompson.

General History of the Gull Island Fisheries Company. The Gull Island Fisheries was started as a single fish pier in the early 1850's by Josiah Hibbard and Ebenezer Allen. It specialized in ground fish,[3] including cod, haddock, hake, and cusk. Production activities had been gradually expanded to include slow-frozen, cured, dried, and smoked fish for domestic and export trade, as well as frozen bait for fishermen. Over a period of years, equipment, processes, labor force, internal control, contact with fishermen, marketing, and financial programs were built around the specific products to be sold. The business continued in the hands of the descendants of the founders until Mr. W. K. Williams bought practically all the stock of the company and assumed active control. Under his leadership the company continued to return a handsome profit on the money invested. Larger fish companies often referred to Gull Island Fisheries as one of their most respected and profitable small competitors. Mr. Williams continued the drying and salting of fish as the main activities of the company, although he was aware that public demand in regard to fish was changing. The market was demanding fillets[4] to an increasing extent. The introduction of quick-freezing processes appeared to be giving a greater impetus to the filleting business.

Mr. Williams often talked this situation over with Glen Perry, a young man whom Williams had taken into the business as treasurer of the company. Williams believed that Perry would become a successful businessman. He had a good mind. He was energetic and was a tireless worker. He had had no previous experience in the fish business. From the beginning, Perry was enthusiastic over the possibilities of filleting fish. The more he studied the matter, the more he became convinced that the company should at once install a quick-freezing unit and begin active competition for the fillet trade. On every possible occasion he urged such a course upon Williams. He pictured the entire Middle West as a market for fillet exploitation. Mr. Williams was intrigued by the possibilities of a wide distribution of fillets, but because the company was still selling its present products at a good profit he hesitated to make the change. When Mr. Williams died, Perry took over active charge of the business. One of the first major changes which he inaugurated was the installation of a quick-freezing unit.

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[3] Ground fish are fish which live on or near the floor of the ocean.

[4] Fillets were slices cut from the sides of the fish and contained the choice meat.

Plant, Buildings, and Equipment. At the time Mr. Williams bought a controlling interest in the business, the plant, buildings, and equipment included the following:

Ground space: 3½ acres
Wharf frontage: 350 feet with 16 feet of water at low tide
A four-story cold-storage plant: capacity, 200 barrels of fish daily; storage capacity, 1,000,000 pounds
Salt house: capacity, 3,000 hogsheads
Smoke house: capacity, 15,000 pounds of finnan haddie daily
A two-story main fish factory: capacity, 2,000,000 pounds
Curing sheds, "flakes," coal bunkers, boiler house, storage and repair shops, and freight sheds, adjoining which was a steamboat landing

The plant now embraces 100,000 square feet of floor space, lighted by electricity and with ample hydrant and fire protection. There is sufficient space and hogsheads enough to salt 2,000,000 pounds of fish at one time.

The plant, which is valued at $200,000, was built out of earnings of the business; and while the total investment is not large in comparison with many industrial establishments, it is, nevertheless, considered a satisfactory unit of its kind and, except for one or two periods of unfortunate management, has always been a very profitable enterprise. However, no appreciable reserve has been accumulated, and any such major expenditures as might arise with contemplated changes will call for additional financing.

Difficulty of Production and Market Correlation. There are certain difficulties that seem inherent in the fish business. The managers of the Gull Island Fisheries Company, for instance, find it exceedingly hard to coordinate effective marketing and production programs. The demand for fish is not continuous like that for beef or bread. To an amazing extent it is controlled by social, racial, and sectarian customs; it is neither steady throughout the week nor does it conform to seasonal changes in the industry. In summer, when fish are abundant and conditions propitious for catching and packing them, demand is weak; in winter, when fish are scarce and fishing conditions hazardous, demand is strong. The Lenten season usually more than exhausts normal local supplies. The most effective correlation between production and distribution is obtained in those fish-packing plants which have large amounts of working capital. These concerns purchase large quantities of fish when the runs are at their peak and hold the finished product until the market is strong. Companies which are so situated financially that they can follow this policy are almost certain of realizing handsome profits.

Influence of Raw Material Supplies. A steady predetermined flow of raw materials, that is, of fish, to the factory is impossible. The fisherman has to make his catch while fish are abundant or he will lose it altogether. Thus he works long, hard hours when the run is on, but no one can forecast exactly the time, length, or size of a season's run. As a result of this situation, the factory has to purchase its fish when they are available even though such purchases may not be best suited to the wishes of the company. The extreme perishability of the product adds to the acuteness of the situation and makes for a condition whereby at times the factory is taxed to its fullest capacity, at other periods it operates only part time, and at still others it shuts down production altogether. Production programs must be flexible in the extreme.

Production Processes. Production processes in the plant are relatively simple. Fish are unloaded onto the company wharf where they are weighed and sorted according to size and kind. The processing operations from that point on depend on the kind of product into which the fish is to be converted and the extent of dressing operations (if any) which already have been performed.

If the market seems favorable, fresh fish (iced) are dispatched to Boston and New York City. If the fish have not been previously worked on, they are headed, gutted, and thoroughly washed, after which the fish are wheeled to the freezing room for thorough chilling (which takes two to three hours). The fish are then wrapped in parchment paper, packed in iced boxes, and hurried to the market. The company can dispose of a small percentage of its product in this manner. A larger portion is slow frozen and put into cold storage to be shipped when prices are favorable.

If the fish are to be cured, the head and back are split until the fish is flat like an open book. After gutting and thorough rinsing, the fish are placed in butts (hogsheads) and saturated in brine. The curing process consumes a few days to three weeks, depending on whether or not the fish have been cleaned and salted on shipboard, but the fish can remain in the butts for long periods without injury. Shipment is made in barrels, kegs, or wooden pails.

When fish are to be dried, they are first cleaned and washed, after which they are piled in the open on wooden racks called "flakes." The length of time they must remain in the sun depends on weather conditions and on the use to which the dried fish are to be put. Each night they are collected and covered as a protection against the cold, damp atmosphere. If weather conditions are unfavorable, the fish are sent to the drier after they are removed from the flakes. Fish for export are generally sent back to the flakes for a second hard finish, after which they are packed in drums for shipment. If the product is to be salt-dried, it is either packed directly in drums or made into cakes or bricks. The latter process means that fish so used have to be skinned, boned and cut, and each cake or brick wrapped in parchment paper. Fish are also shredded and made into prepared fish cakes.

The particular operations through which smoked fish pass depend, as in other products, on the ultimate product sought, whether it is to be finnan haddie or plain smoked fish and whether it is for domestic or export use.

Development of Filleting Business. The successful production of fillets has depended upon the introduction of quick-freezing processes.

The fillet differs from the older method of preparing the fish in that it includes only two large slices out of each fish. These are the choice meat, and if properly cut contain no bones. They are thus not only better in quality but also easier to handle in the kitchen. They can be cooked more easily and are much more attractive on the table. There is nothing particularly new in the fillet idea. The very select trade has demanded them for years, but most fish packers have assumed that this demand would be limited to the small class of buyers who are willing to pay extra-fancy prices. However, the demand for fillets now appears to come from everyone, and if the prospective purchaser cannot get what he wants, there is abundant evidence to show that he turns his choice to meat, fresh fruits, and green vegetables. The more progressive fish-packing concerns recognized the situation.

Since the filleting process was introduced by the Gull Island Fisheries Company, fish are still received at the wharf as heretofore. The cutting, however, is different. Only the fillets are removed. The process essentially is simple, but it requires dexterity and cannot be entirely standardized because each fish has its own characteristics and presents an individual problem. The shape and size of the fish and the thickness and desirability of the fillets are matters governed by such factors as the season of the year, the kind of food upon which the fish has been feeding, and the depth at which it has been living. A carefully cut fillet from a first-class fish brings more in the market than a fillet cut from the same fish in a haphazard manner. On the other hand, if a fish is naturally inferior, careful cutting cannot make a first-class product.

A fundamental problem in the production and sale of fillets has been the marketing of the product. The slow-freezing process permitted shipment for short distances only. The advent of quick freezing would open the entire Middle West as a potential market for fresh fish, a territory which heretofore has been but little exploited by the New England fisheries. It was to secure the advantages of entering the Middle West with fillets while the market was still unexploited that was the outstanding consideration in the new president's mind when he decided to install a quick-freezing unit.

Labor Supply. The labor needs of the packing plant vary, of course, with seasonal activities. Except for the shipping department, watchmen, etc., the plant is virtually shut down after the first of each year, and continues that way until late spring when the season's run starts. The plant continues in active operation until well into the fall. The number of employees varies from 10 to 70, depending on the extent of operations to be performed.

The labor supply of the company has always come from Littletown, a small village near the plant. The type of labor available is the kind usually found in small country villages, although the inhabitants of Littletown seem more provincial than the residents of most small places. They distrust innovations of all kinds and pursue the even tenor of their way just as their fathers and grandfathers did. The number of men available in Littletown is more than ample for the needs of the factory.

Raw Materials Waste. Raw materials waste is an annoying problem for the Gull Island Fisheries Company. No matter whether the product is fresh-frozen, cured, dried, or smoked, there is a considerable part of the fish that cannot be used. In fact, 30 to 35 per cent of each fish is not utilized. This waste includes heads, livers, bones, parts of the skin, and the entrails. In some cases, companies have installed machinery to utilize some of these products; but the Gull Island Fisheries Company has never operated such units, and its waste, except livers, has always been dumped into the ocean. Residents living nearby have recently petitioned local health authorities to have this practice stopped.

The introduction of the filleting process has made the above situation more acute because of the fact that when a fish is filleted, what remains cannot be smoked, salted, dried, or cured for market. This means that the new process is more wasteful than the old; in fact, it has increased the waste to about 55 per cent of the fish.

The greater waste resulting from the filleting process has brought before the Gull Island Fisheries Company the whole question of effective utilization of such materials in the form of salable by-products. The new president has made a survey of the problems which are involved. He reports that other fish concerns have installed successful units for the production of fish flakes from the flesh remaining after the fillets are cut; of fish meal from the bones; of glue from heads, bones, and skins; of cod-liver oil; and of isinglass from the sounds. He believes that similar units would be successful in his own plant. He points out that with the utilization of the entire fish the Gull Island Fisheries Company will be in a position to realize the fullest benefits of the filleting process. The company will receive a top price for steaks and make a good profit on the remaining parts of the fish. He is of the opinion that the only thing which stands in the way of a realization of his plans is lack of adequate finances. The installation of the quick-freezing unit has strained the credit facilities of the company.

On the basis of the foregoing findings and the following process descriptions, what would you as an industrial engineer have advised the credit manager of Kendall and Thompson?

Appendix A Fish Flakes and Fish Meal

The process of making fish flakes provides a relatively simple way of utilizing the edible parts of the fish that are left after fillets have been cut.

After the fillets have been removed, the fish are put into large retorts filled with hot water and cooked for 20 minutes. They are then removed from the water and shaken by hand until the flakes of flesh fall from the bones. The flakes are put into cans and again cooked for a short time, after which the cans are put on an endless belt and passed to the sealer. The sealed cans are immersed in another retort and subjected to intense heat in order to complete the process of sterilization and to test the cans for leaks. They are then labeled and packed for shipment.

Another by-product is meal made from the bones. Such meal finds ready sale in the Middle West, where it is used as a chicken feed. After the flakes have been removed, the bare skeletons are put through a grinding process and reduced to a fine meal which is then ready for packing and shipment.

Fish meal may also be made from the heads, tails, and fins. After the oil has been taken out, this meal has a high protein content which makes it desirable food for cattle, swine, and poultry.

Appendix B Fish Glue

Fish glue is made from the heads, bones, trimmings, and skins of fish, chiefly of cusk, haddock, hake, and pollack. The product is graded commercially on the basis of the raw materials; head glue is least valuable, bone glue next, and skin glue of greatest strength and value. Fish glue is used in the shoe trade, in bookbinding, and for flexible adhesives, such as court plaster, labels, and stamps. Cheaper grades are used in joinery work and sizing operations. Fish glue is marketed in liquid form. The color depends on the material. Head and bone glues are turbid and brown but may be bleached to a light yellow. Skin glue is clear and light in color.

Cod and cusk skins yield 60 to 80 gallons of glue per ton of stock; hake, haddock, and pollack, 35 to 45 gallons; trimming and bones, 25 to 30 gallons; heads, 12 to 18 gallons.

In order to make glue profitably, the supply of raw materials must be abundant and steady. The manufacturing processes, however, are very simple.

The raw material is sorted according to the kinds of glue to be produced. It is then put into wash mills and washed with fresh water to remove dirt, blood, and salt. From four to six changes of water are used. For this purpose, an abundant supply of pure water must be available. Frequent tests must be made to ascertain the salt content of the stock, which should be kept below 1 per cent. The material is then put into tanks and cooked for about two hours at a temperature just below the boiling point. After being tested, the glue liquor is drawn off into other tanks and run through a filter. It is next run to the evaporator and evaporated to the desired consistency, usually about 50 per cent solid to 50 per cent liquid. The glue may be bleached, if necessary, before evaporation. When the right consistency has been obtained, the glue is pumped into storage tanks where it stands for a day before being put into containers for market. Here, preservative chemicals may be added, and frequently wintergreen or sassafras is added to disguise the odor of the glue. The production of high-quality glue requires the careful use of chemicals as clarifiers and preservatives. Higher grades of glue are put into tubes and bottles, and other grades into barrels or cans.

Appendix C Isinglass

Isinglass is a collagen in the fibrous layer of the "sounds," or swim bladders, of fish. The sound is a hollow sac containing a gas and located just beneath the backbone. By compression and expansion of this sac the specific gravity of the fish is changed.

The best quality of American isinglass is prepared from the sounds of hake caught off the northeastern coast. If the fish is dressed on shipboard and the vessel is to remain at sea for several days, the sounds are taken out and salted down in barrels. One ton of hake will yield 300 to 500 large sounds which will weigh 40 to 50 pounds.

When the sounds are brought in to be processed, they are split and dried in the open air. Later they are soaked until soft, chopped into fine pieces by a cutting machine, and macerated between a set of iron rollers. The material is next passed through the sheeting rollers and pressed into sheets $\frac{1}{8}$ to $\frac{1}{4}$ inch thick and 6 to 8 inches wide. These sheets are reworked by another set of rollers into ribbons about $\frac{1}{64}$ inch thick and still 6 to 8 inches wide. The ribbons are dried quickly and wound on wooden spools in pound lots.

Isinglass has various commercial uses. It is used as a clarifying agent for white wines. It is no longer used in the preparation of jellies and confectionery, but it is of value in the sizing of silk, in making cement for mending china, as a waterproofing compound for textiles, and as a dressing for leather.

Appendix D Cod-liver Oil

Oil is extracted from the livers of cod for medicinal and technical uses. The nonmedicinal oils are of two grades; the higher grade is taken from cod livers alone and the lower from a mixture of cod livers with the livers of haddock and other fish. The medicinal oil is taken from the livers of fresh-caught cod in prime condition. The vitamin content of the oil depends on the condition of the fish, the season of the year, and the locality in which the fish is caught. In certain areas, minute marine vegetation grows on shallow banks and ledges where sunlight penetrates. Such areas are found off Newfoundland and on the Atlantic Banks. If the cod has fed on the small fishes which subsist on such vegetation, the vitamin content of the oil is high.

The oil is extracted from the livers in steam-jacketed pans or by direct steaming. The stearin, which is said to make the oil unpalatable, is removed by a chilling process, the crude oil being pumped through cooled pipes from which the clear, nonfreezing oil flows into containers ready for shipment. There are many variations in the process and equipment used in extracting the oil, and changes and improvements are still being made, the chief object of all of them being to protect the oil from oxidation by contact with the air, which increases the unpleasant flavor.

The residue of the livers after the oil has been extracted may be utilized as chicken and cattle feed since it also has a high vitamin content.

7

DYNAMICS OF INDUSTRY—CONTRACTION

QUEEN PAPER MANUFACTURING COMPANY

1. A COMPANY CONTRACTS ITS SCALE OF OPERATIONS

The Queen Paper Manufacturing Company operated two paper mills, one at Anderson and the other at Biltonville. During a period of business recession, the decline in volume of business so increased the unit costs of products manufactured that the management of the company thought it wise to close the mill at Biltonville and transfer all activity to the Anderson plant.

2. NATURE AND CAUSES OF PLANT CONTRACTION

The forces of our dynamic society sometimes make contraction of manufacturing operations desirable. Shifts in market demand, new developments in products and production methods, and changes in general business conditions—one or all of these influences may have an impact on a particular producing unit that results in reduction in sales with concurrent lessening of plant activity.

The buying public is notoriously fickle. Random changes in demand result from style shifts and the rise and fall of fads. When the trend to shorter skirts for women gave the hosiery producers a tremendous increase in business, it at the same time curtailed the demand upon manufacturers of dress materials to such an extent as practically to wreck marginal producers of such goods. The ramifications of style changes have brought to industrialists many sleepless nights. Fads frequently soar to unexpected heights and then even more quickly disappear. The jigsaw puzzle flashed into only brief popularity. Men's bright-patterned sport shirts "come in," but for how long no one knows. Occasionally fads are predictable, but more often their rise and fall are nearly impossible to understand. Nevertheless, manufacture in industries affected by such influences must be carried on with expectation of such rapid change, and knowing when and how to contract operations is a definite responsibility of industrial managers.

Fully as important for studied consideration as random changes are seasonal shifts. Much of American manufacture is subject to this type of influence. Cosmetics, radios, textiles, automobiles, building materials, and even foodstuffs are subject to the influence of changing seasons. Under such conditions, the manager squarely faces a dilemma. He may manufacture for stock during seasons of low demand, thereby accepting all the costs and risks of large inventory investment, or he may operate at alternately high and low rates of activity. The latter course involves the costs of a noncontinuous labor force, congestion of work, and idle plant and workers, which are problems of great import from a profit standpoint. Fortunately, seasonal variations in demand can usually be foretold, and thus warned, manufacturing executives can plan. The methods of attack upon this problem are many and varied. Some concerns produce continuously and warehouse the excess output of dull seasons. Others expand and contract manufacture seasonally to correspond with the swings of seasonal demand. Still others go part way, curtailing somewhat during months of slack demand and accumulating some inventory beyond current needs. Other managements have searched assiduously for products of opposite seasonal characteristics to absorb the inactive capacity of plant and labor during slack times. The problem is difficult, and there is no one answer. The following factors are among the major considerations in finding a suitable solution to the individual problem: the availability of labor supply; the relative importance of labor, raw materials, and burden costs; the predictability of forthcoming demand; and the importance of style elements.

Development of competitive products is a common cause of decreased demand. When phonographs became popular, piano manufacturers had to curtail their activity. Radios produced a like effect upon phonograph manufacturing. Then television reduced the demand for radios, and currently stereophonic record players have brought phonograph records back into high favor with buyers. Rayon influenced both cotton and silk demand. Then nylon has had its impact on all three. Wide-awake management usually will foresee such change and be prepared for it. Occasionally, however, the influence is so indirect, or management so obstinate in its faith in the existing order, that disaster follows. Under the best of administration the problem is a serious one, and the degree and method of curtailment almost always constitute puzzling problems.

Shifts in consumer demand are not the only cause of production fluctuation. Improvement of a production process may throw a hitherto low-cost producer into the high-cost class. For years the electronic circuits of radios and television receivers were hand wired; each connection was soldered individually. Then the printed or etched circuit board was developed. This eliminated most of the hand soldering and substituted an entirely different and much less costly process. Most recently the etched or printed circuit board is being replaced for many purposes by a die-cutting process which stamps out the board and its circuit in a single cut on a press. This process is much faster, and when volume of output is sufficient to warrant the cost of making the dies, much cheaper. The manufacturer who utilizes electronic circuits in his product has of necessity to change from one process to each newer process as it develops. If he does not do this he may become a high-cost producer, a victim of the competitive forces of technological change.

Under such circumstances, management has but two choices: follow suit and attempt to regain competitive position, or accept the fact of relatively high cost and depend on various means of maintaining a profit at a somewhat lower rate of output. On the surface, the former course seems the more sensible. There are times, however, when the gains of process modernization may not be entirely worth the cost, and the clever manager may then well accept the change in status, reduce his scale of operation, and look for some other way out.

Process change is only one production cause of volume change. Product improvement and equipment improvement are others. Unfortunately, from the standpoint of the outmoded producer, advancement in products and machines may be made more binding by means of grant of patent rights. While probably of less import than is usually supposed by the novice, the monopolistic aids of patent protection under sound management are upon occasion ruinously destructive of volume of the less fortunate competitor.

Governmental activities not infrequently make for changes in rate of operations of this or that producer. The possibility of tariff reduction sometimes constitutes a threat of output decrease. The postwar industrial recovery of many foreign countries—Germany, Italy, Japan are examples—has brought many American manufacturers face to face with low-cost high-quality product competition from these sources. This competition is likely to increase in intensity and scope. The development of the European Common Market gives producers in this area a volume market they have not enjoyed in the past. Large scale production in Europe and in Japan is developing with this assurance of wider and freer markets. The impact of this on prices of quality foreign goods offered in our markets is a matter of concern to many producers in the United States. If we are to retain constructive world leadership, we cannot meet foreign competition simply by erecting tariff walls against this influx. Nor can we expect foreign consumers to buy the products of our industries if we refuse to allow entry of their products to our markets. Since 1936 our government's reciprocal-trade-agreement program has resulted in decreased demand for some United States producers as well as increases for others. Import, export, and monetary controls exercised by our government and by foreign governments will continue to result in expansion of some and contraction of other manufacturing enterprises in this country.

Last, and sometimes the most serious of the changes affecting rate of output, must be considered the influence of general business conditions. The phenomenon of the business cycle is familiar to all, as likewise are its effects upon the rate of output of the individual manufacturer. Unquestionably, the most critical aspect of this problem to an individual management is the question of how to cut down operations so as to minimize any long-time adverse effect upon the business. The greatest difficulty is inability to read the future. The experienced executive knows that far greater change takes place in a period of recession than in a like period of prosperity. Simply to shut up shop and wait for the sun to shine again is suicide. Even to curtail at all is a difficult decision psychologically, and as a result the early months of a generally declining demand commonly see producers turning out unneeded volume at the old rate. The cause is probably fear of the effect of reduced operation on costs and profits. The result is accumulation of excessive inventory and acceleration of decline in price.

That the decision to reduce or cease operations cannot be made lightly, no one will deny. The considerations and effects thereof are many and widespread, and rare indeed is the executive who can foretell the result consistently and with accuracy. The experience of the Queen Paper Manufacturing Company, discussed briefly here, illustrates the nature of the problem and the considerations involved. Essentially, it is typical of what a management faces when recession or depression exists generally.

3. SITUATION IN THE MILLS OF THE QUEEN PAPER MANUFACTURING COMPANY

The Queen Paper Manufacturing Company operated two paper mills. One mill was located in the city of Anderson and the other in Biltonville, 100 miles distant. Anderson was a city of 40,000 inhabitants, with a variety of manufacturing establishments. Biltonville had only

2,000 inhabitants, and the paper mill was its only manufacturing enterprise. When operated at capacity, the Anderson mill produced 1,306 tons of paper and the Biltonville mill 478 tons of paper during a four-week period. Only one grade of paper was produced at the Biltonville plant, whereas this grade and several other grades were manufactured at the Anderson mill.

Because of a reduction in orders during a period of general business recession, the mills had been manufacturing chiefly for stock. Production was only 61.5 per cent of normal capacity at the Anderson mill and 50 per cent of normal capacity at the Biltonville mill.

An investigation by officials of the company showed that when the rates of operation at the two mills were decreased, production costs per unit of output were increased. Production costs were made up of three classes of items: raw materials, labor, and burden. The raw materials charges of the Queen Paper Manufacturing Company were an important item, for the company had long-term contracts for pulpwood, drawn up on the basis of anticipated normal annual needs. Thus, when production at Anderson and Biltonville was reduced to 61.5 and 50 per cent, respectively, there was an immediate piling up of raw materials inventories in the storage yards of the company. Since these raw materials could not be put into production at once, a large amount of capital was tied up in a nonliquid investment from which the owners could secure no immediate return.

Labor costs also were an important consideration. If the two plants were to operate at less than normal capacity, the number of workers would have to be considerably reduced. The production managers, however, were reluctant to make substantial cuts in the working force because it is expensive to organize an efficient factory personnel. If, for example, one-half of the workers at Biltonville were laid off, these men would doubtless seek work elsewhere, and many of them would eventually be lost to the Queen Paper Manufacturing Company. The company had made a real investment in these workers. It had paid out money to secure them and train them into an effective organization. If these men left Biltonville, the company would pay out more money in securing, training, and adapting other workers to fill vacancies when business again returned to normal.

An expedient commonly adopted to meet a situation such as that which the Queen Paper Manufacturing Company was facing is to shorten the workday or the work week. In this way each employee secures his proportionate share of work even though it is not a full day's or a full week's work. But the problem at the plants of this company was complicated by the fact that papermaking is a continuous process. The costs incident to stopping and starting paper machines make it imperative that these machines be kept constantly running.[1]

The Queen Paper Manufacturing Company could meet this situation in part by reducing the speeds at which the machines were operated, since rates of machine operation were controllable within certain limits. When the speeds of the machines were reduced, however, certain disadvantages at once appeared. The entire system of planning and operation was thrown out of adjustment and had to be reorganized to meet the new conditions. Many of the former benefits of a high degree of specialization were then no longer applicable. Furthermore, the management soon discovered that employees working at less than normal speeds easily fell into slovenly habits, and the problem of quality control of product quickly became important. These disadvantages obviously tended to increase the unit cost of production.

Burden charges at the two mills were made up of such items as insurance, taxes, power, heat, light, steam for fire pumps, and depreciation on buildings and equipment. The costs of these items went on day after day and bore no particular relationship to the rate of production at which the mills were operated. The normal way by which the management of the Queen Paper Manufacturing Company secured funds to pay these costs was by producing goods for sale. Each unit of goods produced had to bear its proportionate share of total factory expense. If the number of units was reduced by 50 per cent, as was true at the Biltonville mill, then the unit burden costs of production at that mill would be approximately doubled, for there would be only half as many units over which to distribute the fixed cost of production.

It is clear, then, that labor and burden costs at both the Anderson and Biltonville plants tended to remain constant and bore no fixed relation to the rates at which the plants were operated. This was due in part to the nature of the labor requirements, which made it highly desirable to keep the working force together if possible, and in part to the fact that the majority of the items listed as burden charges were constant expenses of production irrespective of whether the mills operated at capacity or at only 50 per cent of capacity.

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[1] There is waste involved in the shutting down of paper machinery because it takes considerable time to put a paper machine into operation and to start the paper running through it. There is waste in cooling and reheating the drying cylinders, and the paper which is run immediately after a shutdown is not marketable.

4. ADVANTAGES OF CLOSING ONE MILL

After watching the situation carefully for a number of weeks and seeing no likelihood of immediate relief from the recession, the general manager of the Queen Paper Manufacturing Company suggested that in his opinion it would be more profitable for the company to close down the Biltonville mill entirely and to transfer all production to Anderson until such a time as business showed evidence of picking up. He believed that in this way overhead expenses might be reduced at the Biltonville plant and the output of the Anderson mill raised from 61.5 to 80 per cent of normal capacity.

The general manager estimated that when manufacture was carried on at the existing rate, the overhead costs for a four-week period were $135,191 for the Anderson mill and $70,039 for the Biltonville mill. If the latter was shut down and its tonnage transferred to the Anderson mill, the overhead costs would be $141,757 for the Anderson mill and $30,893 for the Biltonville mill. Overhead costs for the Biltonville plant when it was shut down would consist of taxes, insurance, depreciation, power for lights, steam for fire pumps, and salaries for superintendents, including four foremen.

5. DISADVANTAGES OF CLOSING ONE MILL

The plan, however, was not without certain drawbacks. Beginning operations when business revived would involve expense for initial repairs, recruiting labor, and building up the organization. After such a suspension, only an inferior quality of pulp could be produced, and paper made while adjustments were being set was not of the first grade. The expense of starting the Biltonville plant after a four-week shutdown was estimated to be $33,000. This expense would increase $2,000 for each consecutive four-week period during which the mill remained idle.

If the Biltonville plant was closed, the employees could not find other work in the town, and many of them, undoubtedly, would leave. Such a condition would cause the whole community to suffer. Workers would have to be imported when the plant resumed operations, and it would probably be difficult to build up a new crew as capable and loyal as the existing one. The management had experienced no labor troubles in the plant, but there was a possibility that the imported workers might be of a radical frame of mind, and thus labor agitation might be started. It was possible to retain a portion of the more skilled workers by offering them an opportunity to go to the Anderson mill, but only a limited number could be so accommodated. To close the Biltonville mill involved a loss of prestige, since the work of the service department there had been held up to the whole paper industry as a favorable example.

6. WHY THE BILTONVILLE MILL WAS CLOSED

In spite of the objections which stood in the way of shutting down the Biltonville plant, executives of the Queen Paper Manufacturing Company believed it imperative to reduce unit burden costs. Consequently, the Biltonville mill was closed and all production transferred to Anderson. The increased number of units then produced at Anderson (80 per cent of normal capacity) made it possible for the management of that plant to reduce unit burden charges from what they were when the plant operated at 61.5 per cent of capacity. Under the new arrangement the number of units produced in the Anderson plant was increased 19 per cent, while the overhead costs at that plant increased less than 5 per cent. This meant that there was a larger number of units over which to distribute the costs of operation, and consequently the cost per unit of the product manufactured was lowered. Lower unit costs of production make possible a lower price to the consumer.

As month after month went by and no cessation of the depression appeared, the costs of keeping the Biltonville plant idle accumulated rapidly. The only means by which the Queen Paper Manufacturing Company could offset these losses was by the sale of products produced at the Anderson mill. In other words, this mill had to carry a double load. This finally proved too great, and the executives of the Queen Paper Manufacturing Company decided to sell the plant at Biltonville and to give their undivided attention to the operations of the Anderson mill.

The decision to close the Biltonville mill temporarily seems sound. Had the recession been of short duration, the reduction in costs resulting from the shift would have been insufficient to cover the expense of putting the Biltonville mill into operation again. As time elapsed, the resultant savings accumulated more rapidly than did the growth in reopening costs, and the wisdom of the management's action became clear.

The desirability of selling the Biltonville plant is not so obvious. It was a highly specialized unit and possessed substantial production economies for the manufacture of the type of product for which it was designed. Unless the future showed that demand for this particular paper had become permanently curtailed, return of prosperity would find the Queen Paper Manufacturing Company at a disadvantage. However, Queen Paper management knew from experience in earlier years that accumulated losses from retaining an idle mill during long periods of depressed demand can become prohibitive. It might require years of successful management after business again becomes active to wipe out these losses.

In the field of finance the principle of quickly cutting losses has long been recognized. In the area of manufacturing, management commonly has been less quick to grasp its force. The experience of the Queen Paper Manufacturing Company is an excellent instance of the need of farsighted management, exercise of judgment, and sound decisions in terms of an unknown future.

7. SUMMARY AND CONCLUSIONS

Effects of Subcapacity Operation on Costs. A common characteristic of American management has been an appreciation of the effects of subcapacity operation on burden costs. Exhibit 1 on page 182 is designed to show graphically the effects of subcapacity operation upon the production cost elements: raw materials, labor, and burden. In the diagram the process is represented by the continuous conveyor, the process flow being from right to left. Raw materials are put in process at *A*, labor is applied at *B*, and burden at *C*. The frequency with which raw materials are put in process is under the control of management. This control is represented by the gate valve at *A*. By means of some device, such as piece rates or variation in the size of the work force, raw materials may be made to carry a relatively uniform amount of labor cost even though the volume of production, determined in this case by the rate of release of raw materials, is not uniform. The valve at *B*, automatically tripped by the raw materials as they reach that point, represents such control. At the outlet of the burden reservoir, C, no such controlling device exists. That outlet is always open, and the burden flow is therefore continuous. When work in process is passing beneath the outlet, it absorbs burden. If no work in process is beneath the outlet, the burden flows on just the same. It is in this respect that burden costs are so greatly different from labor and raw materials costs. The latter two are usually largely under the control of the operating personnel. Burden is not so flexible or so readily controlled; it tends to be constant. Its volume flow is somewhat affected by the rate of plant operation. As the rate decreases, certain burden items tend to fall off and certain items tend to increase, but the greater portion does not vary. Therefore, in the diagram, the outlet of the burden reservoir is shown as always being wide open.

For this reason, production at less than plant capacity tends to increase unit operating costs, for while a decreasing portion of burden cost is absorbed by the product itself, the remainder, the wasted burden expense, must be borne by the company and is a charge against its profits. This unabsorbed burden is shown in the diagram by the unabsorbed burden accumulation tank beneath the conveyor system. When no work in process is beneath the burden reservoir outlet, the perpetually flowing burden falls through and is accumulated in the tank below. It must be remembered that burden waste is just as effective in increasing unit costs as is the burden which is immediately absorbed by work in process on the conveyor.

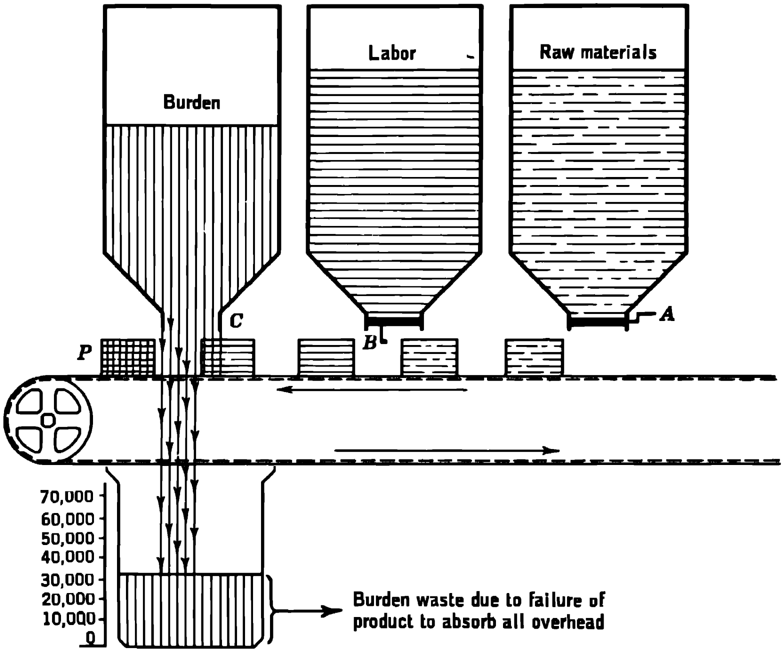

Exhibit 1. Diagram to Illustrate Characteristics of Cost Application.

It is apparent, then, that in the diagram the level of burden accumulation in the waste tank will be determined by the frequency with which raw materials are released into process at point *A*. The more frequently raw material units are fed upon the process conveyor, the smaller will be the spaces between the product units in process. The smaller these spaces between product units, the less burden will leak through into the waste tank. The larger these space intervals, the greater will be the flow from burden reservoir into burden waste. The ideal condition would be shown in the diagram if the product units in process were tightly packed against each other on the conveyor. Then all burden flow would be absorbed by the product flow and none would escape into the waste collector.

In practice such an ideal is rarely, if ever, attained. Few plants operate through the 24 hours of the day. It is no easier to shut off burden in the dark than it is in daylight. Most products are subject to seasonal demand. There are periods of recession and periods of business activity. Competition causes further variations in the already irregular product flow. It often is difficult, even impossible, to determine just how large a plant should be. Thus, unabsorbed burden is to be expected; provision for its accumulation must be made, and its depressing effect upon profits anticipated.

Though inevitable, this condition is not hopeless. Informed management knows of and understands the situation, and effective management will keep waste burden at a minimum. The level of waste burden in the diagram tank will provide a means of measuring the efficiency of management in this respect. Who is responsible for this control of burden waste? This question can be answered by an analysis of the factors which tend to raise or lower the level in the waste tank. By providing an outlet for the company's products, good sales management will tend to reduce the level. At times the best of sales management cannot dispose of a plant's maximum output. A general business slowdown might be responsible for such a situation. Again, existence of demand does not ensure maximum output. Factories do not run themselves; careful production planning and supervision are necessary all the way down from the plant superintendent to subforemen and stockroom clerks. Materials do not automatically release themselves into process. Control of this function at point *A* in the diagram is a management job. The degree of excellence with which this work is carried out will have a direct effect upon the amount of burden that is wasted. Released raw materials will seldom pick up automatically an efficient labor application at point *B*. The longer it takes to make the necessary labor application, the more the process is slowed up and the greater is the burden waste. Effective utilization and motivation of labor are management jobs. Burden control is not the responsibility of any one executive in an organization. It is a problem that can be solved only through the cooperation of all who are concerned with management functions. In fact, under certain circumstances, its solution may in considerable measure be beyond the complete control of the management of any single business unit.

This does not mean, however, that the point in the diagram scale at which the level of waste burden rests cannot be used as a means of measuring management efficiency. It is possible, with a considerable degree of accuracy, to isolate the effects of plant management upon burden utilization and thus place responsibility for profit fluctuations arising from changes in volume of operation. Continuous operation at maximum plant capacity, 24 hours a day, 365 days a year, has been pointed out as the ideal condition so far as unit burden costs are concerned. This ideal is rarely obtainable or advisable. A study of the past operating experience of the company will give what may be termed a normal rate of operation. This normal rate will consider good years and bad years as well as average years. The number of labor dollars expended during such a normal period can be determined, and the ledger accounts of the company will show the total burden incurred during that period. The burden cost per labor dollar, or burden rate, at normal production is determined by dividing the total burden cost by the number of labor dollars paid out. This normal burden rate can be used as a standard just so long as it can fairly be considered normal. In practice it is possible to set a standard that will operate successfully over a period of several years without revision. This standard provides a means of measuring current efficiency in burden control and to a considerable extent makes possible the determination of responsibility therefor.

To use such a standard it is first necessary to determine the actual current burden cost for a period of time: one month, three months, six months, or a year. This current cost can then be compared with the standard cost for that period.[2] Variations from normal are thus revealed irrespective of changes in volume. When the current unit cost is greater than standard, burden is said to be underabsorbed. (Burden in excess of the normal amount is escaping through the production line into the waste tank.) When current unit burden cost is less than standard, burden is said to be overabsorbed. (Production processes are absorbing more than the predetermined normal amount of burden flow, and the waste level in the accumulation tank is below the normal point in the scale or is receding.)

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[2] The standard cost can be obtained by totaling the burden charges on the cost sheets of the period. On each cost sheet the burden entry has been calculated by taking the labor cost and multiplying it by the standard burden rate. Example: Labor costs on a cost sheet amount to $148. The standard burden rate in use in that department is 80 per cent. Multiplying the labor cost, $148 by 0.80, will give the standard burden cost, $118.40, for the production covered by that cost sheet. Totaling these standard burden costs for all cost sheets for the period under consideration will give the total standard burden cost for the period. Not infrequently, the regular accounting procedure is designed to show the relation of actual to standard burden costs at frequent predetermined periods.

Causes of and responsibility for underabsorbed and overabsorbed burden can be determined through study of current volume in comparison with normal volume, existing general business conditions, individual burden cost items, and the like. To be effective, such a device must distinguish between plant burden and burden arising from the exercise of other managerial functions, such as marketing and finance. A better analysis may be obtained in a company operating more than one plant if the total plant burden is distributed among the individual operating units. Likewise, within a single plant, standard unit burden may be set for the various departments operated and products produced. Such detailed analysis and comparison make for better determination of causes, fixing of responsibility, and remedy of unsatisfactory conditions. It should be remembered, however, that the collection of detailed cost information in itself tends to increase the very cost which the use of the device seeks to control, namely, burden, and therefore such data should be gathered and used with discretion. Cost information is expensive to gather and in itself has no virtue. It is only when such information is effectively used in the hands of competent management that it will pay its way. If it is properly compiled and consistently utilized, it will increase profits.

There are many ways of furthering the use of information about burden absorption. One of them will suffice as illustration at this point. The effect of burden fluctuation upon operating costs and profits can be made to appear in the periodic operating statement as prepared for the use of the management. Outlines of two methods of presenting the same set of operation facts follow. The first, Profit and Loss Statement A, does not show the effect of burden fluctuation. Profit and Loss Statement B does better in that respect.

Profit and Loss Statement A

Net Sales	$2,000,000
Less, Cost of Producing Goods Sold	1,300,000
Gross Operating Margin	$ 700,000
Less, Selling and Administrative Expense	600,000
Net Profit	$ 100,000

Profit and Loss Statement B

Net Sales	$2,000,000
Less, Cost of Producing Goods Sold (at Standard Burden Cost)	1,200,000
Gross Operating Margin (at Standard)	$ 800,000
Less, Underabsorbed Burden	100,000
Gross Operating Margin—Actual	$ 700,000
Less, Selling and Administrative Expense	600,000
Net Profit	$ 100,000

In Statement A, underabsorbed burden is included as a part of the item "Cost of Producing Goods Sold," and the reader is given no indication of the true situation as to burden costs. The separation of the underabsorbed burden item, as in Statement B, calls the reader's attention immediately to the fact that burden in excess of normal has cut profits to one-half of what they would have been if the burden costs of the period had been no greater than normal. While the example given is a very simple illustration of methods of use of burden cost data, it is typical in that it is a device which tends to make cost data valuable as a tool of managerial control. When available promptly and effectively and when economically used, such data are very valuable. Unless so employed, their collection is one common element which makes for excessive burden cost.

Management Approach to Contraction Problems. As management understanding of burden has grown, there has come to be too great reliance upon volume as a means of keeping costs down. When demand slackens, management too frequently accepts unprofitable business on the theory that it tends to absorb overhead. The reasoning is that just so long as the return is greater than the out-of-pocket costs, acceptance of business at less than total cost is desirable in that it lessens the burden which must be carried by each unit of output. Within limits, this reasoning is accurate. It is important, however, to consider further and to realize that a widespread following of this practice among competitors tends to make more acute the conditions responsible for lack of profit in the first place. The acceptance of nonprofitable business simply to help absorb burden when volume is subnormal is lazy management. It should be practiced only as a last resort when all other means of reducing costs, both of operation and of idleness, have been completely exploited and exhausted. It is common knowledge that businesses are less efficient in prosperity than in continued depression. The opportunities for cutting nonessential costs, for becoming more efficient, are greatest at the beginning of a period of slack demand. Sound management is that management which foresees the necessity of contraction early, management that aggressively puts the production house in order, that effects changes which reduce the total of burden costs as well as materials and labor costs. To accept burden as a completely noncontrollable cost and supinely to do business at less than total cost on the theory that it absorbs burden is not good management. It is more characteristically the course of a little man with a little knowledge—knowledge that is actually dangerous in its long-run effects. Many businesses can be made to operate successfully at less than accustomed volumes. However, such success occurs only if courageous individuals recognize change, accept the new order, plan for profit on the new basis, and take timely action.

Not all contraction in demand is permanent or necessarily of long duration. A major responsibility of executives is determination of the character and probable duration of demand contraction. Action can be taken wisely only when these have been determined. Once executives are convinced of the nature of change in status, it is incumbent on them to take remedial action as directly and quickly as possible. It is frequently difficult psychologically to accept change and to shift unhesitatingly to the most suitable gear. But good management demands just that, for the industrial order is essentially an order of change and calls for adaptability in those directing business.

Causes of Dynamic Society. An analysis of the development of American business shows that at all times our industrial society has been highly dynamic. Business units always seem to be either expanding or contracting. Also, as a whole, business is either going forward or receding. Scarcely ever does it appear to stand still. The causes making for this condition are many and varied, and some of them are but little understood.

In the last hundred years of our history we have had several major cyclical variations which have brought ruin to thousands of industrial establishments. It would be foolish indeed to try to give a single explanation of these occurrences. The earlier ones were closely associated with unrestrained speculation in land coupled with unsound systems of banking and currency. Others have been the aftermath of the destruction of economic wealth in wars. The one which started in the latter part of 1929 was probably caused in part by the destruction of economic goods in the First World War; in part by an inflated standard of living built upon artificial demands caused by the First World War; in part by the failure of consumption to stay in line with increased production; and in part by an almost childlike faith that there was no necessary relationship between the prices for which securities should sell and the immediate capacity of the capital represented by such securities to earn a profit.

Since the Second World War periods of slackened business have been less severe and of shorter duration. Two kinds of conditions seem responsible for this. Social security laws, the development of strong affluent unions, the steady growth of sound investment trusts, and legislation designed to balance the bargaining power of labor and industry make up a front of strong resistance to drastic decreases in purchasing power. The second set of influences is greater availability of knowledge with respect to business changes. Fluctuations in inventory accumulations at all levels from raw materials through manufacturing and distribution to the consumer level are promptly publicized. Other pertinent facts such as retail sales volumes, consumer indebtedness, price changes, and consumer savings constantly are available to business managers. This knowledge plus better understanding of the need for taking prompt responsive action by business managers and government agencies seems to have tended to contain the amplitude of business swings, thereby reducing their severity.

Certainly there is no assurance that in this country severe business depressions never will occur again. There are, in fact, basic weaknesses in our economy. One such weakness is the price of corporate stocks on the organized exchanges. Too commonly these prices are exorbitantly high in that they bear little relationship either to dividends or to earnings of the issuing businesses. Steady depreciation of our currency is, of course, inflation and can hardly be regarded as a stabilizing business influence.

Nevertheless, on balance there seems reason to expect that future tendencies toward excessive business swings will meet strong built-in resistances that did not exist 50, 40, 30 years ago and that, in addition, a basis for earlier corrective action now exists and is being utilized. Today American business is more dynamic than ever. Destructive effects of change probably are less severe in the aggregate. The executive or executives responsible for the profit and perpetuation of any particular business would indeed be foolish to rely on this generalization as security. Forward planning, particularly in the interest of foreseeing change and anticipating its impacts on a business, is a more significant ingredient of managerial success than ever before.

Aside from these general fluctuations, individual industries and enterprises are subject to changing influences. Many business units have pronounced seasonal characteristics. This is true of such products as automobiles, radios, electric air conditioners, oil burners, many cosmetic items, and the like. In the garment industry, in addition to seasonal characteristics, there are style changes which are often so profound in character as to change entirely the type of raw materials needed, the process used, the labor requirements, and the basis of wage payment. Sometimes dynamic conditions are brought about by competition between industries such as bituminous coal on the one hand and gas, oil, and electricity on the other, or as seen in the long-drawn-out conflict between lumber and lumber substitutes.

In the maze of complex relationships which these conditions influence, the individual business enterpriser must so set up his plant and its process as to be able to take advantage of every favorable development and to circumvent changes which would mean lessened profits. The task is not an easy one. It requires a keen knowledge of human nature, of economic principles, of technical processes, and of sound business organization.

The question often arises as to how much the dynamic conditions above described are susceptible to control by business executives. To what extent are these men responsible for such occurrences? One is safe in concluding that the present-day executive has a responsibility which extends beyond the mere securing of dividends for his stockholders, important as this task may be.

The business executive holds a particular responsibility to his labor group for their welfare. Their well-being can be affected by practically every decision which he makes. One questions the soundness of a business policy, for example, which ruthlessly throws workers out of employment simply because a machine has been invented which can take their places. It is certainly not sound social policy to permit such workers to be thrown out of employment in vast numbers, and there is much evidence on the horizon to indicate that if the business executive does not effect the regulation of employment made necessary by the introduction of modern laborsaving machinery, society will attempt such regulation for him.

On the other hand, there are times when the only sound policy is to reduce rigorously the costs of production. This probably was true in the case of the Queen Paper Manufacturing Company. Doubtless there were very real hardships for employees involved in the closing down of the plant at Biltonville. When it came to a choice, however, between shutting down the one plant and jeopardizing the future of all the employees of the company, executives could come to but one conclusion. The decision to close the plant seems sound, not only from the point of view of the stockholders, but from the point of view of society as well. If the plant had attempted to continue in full operation, the company easily might have been forced into receiver-ship, and thus the social gains which the company hoped to bring about would have been lost permanently.

QUESTIONS

1. Why should the modern business unit possess flexibility?
2. Was there anything about the plant at Biltonville which would make it less suited for concentration of production than the mill at Anderson?
3. Explain why it is that, when the rate of operation in a plant decreases, the cost of operation per unit of product tends to increase.
4. Who was responsible for the increased unit cost of production at the Biltonville and Anderson mills when they were operating at 50 and 61 per cent capacity—the president of the company, the mill superintendent, the workers?
5. Why do production managers characteristically dislike to discharge part of their personnel in times of slack business?
6. How did the type of pulpwood contract used by the Queen Paper Manufacturing Company affect profits in a period of recession?
7. What reason is there to think it was a wise plan to shut down the plant at Biltonville?
8. What would be the nature of the costs incurred if the Biltonville mill was reopened?
9. In what way did the Anderson mill have to carry a double load after the mill at Biltonville was closed?
10. Name any circumstances you can in which you think it might be wise to operate a plant at a loss. What dangers are involved?
11. Explain, by use of the diagram, how subcapacity operation affects production cost elements: raw materials, labor, and burden.
12. Explain the difference between Profit and Loss Statements A and B on pages 185 and 186.
13. How may Federal government attitudes and actions on such matters as the prices of farm and manufactured products, the relations of management and labor unions, and industrial workers' wages have an effect on management's thinking with respect to flexibility of the business unit? Cite examples from a daily newspaper.
14. To what problem or problems should present-day manufacturers of military materials be directing their attention? Indicate as specifically as you can the areas in which they should and should not be seeking solutions of their potential problems.

PROBLEM 16 HUMBOLT-CLATSON COMPANY

Humbolt-Clatson Company of St. Louis, Missouri, manufactured and sold direct to retailers boys' underwear of a type not subject to rapid style change. The management effected drastic revision of the company's sales and production policies, which resulted in a significant improvement of company earnings.

Demand for the product of the Humbolt-Clatson Company was seasonal, with peaks in the spring and fall. Garments required for the fall trade differed from those demanded for spring in type and weight of fabric as well as cut of garment. Although the company was a relatively small unit in the industry, years of catering to the individual requests of a large number of retail stores had resulted in a wide line of types and sizes of the garments in the production of which the company specialized. During a generally depressed period of business, volume fell off rapidly in spite of increased effort by the sales department. Currently sales were less than $300,000 annually, and there was every indication that volume would become still less. Past experience had shown that when annual sales volume fell below $600,000, operation resulted in a loss.

Briefly, the manufacturing process carried on by Humbolt-Clatson Company was as follows:

Threads and yarns purchased from specialist producers were knit into tubular fabrics in the knitting room. This was a machine process. Knitting machines were automatic and needed only intermittent attention while in operation. Such attention as was necessary required the services of skilled specialists. The machines were complicated, and the nicety of precision adjustment essential to satisfactory operation called for men trained in the setting up and adjustment of work in the machines.

Fabric from the knitting room went to the bleachery in the basement. There it was bleached, finished, pressed, and wound into rolls. The rolls were either stored or sent direct to the cutting room.

Cutting was done by men skilled in the use of electric-power knives which cut many layers of fabric at one time. Cut parts were bundled and assembled for complete garments in hand trucks.

Stitching of cut parts into complete garments was the next step. The stitching process was divided into a number of detailed operations, such as sewing a single seam, stitching on a label, and attaching buttons. Equipment in the stitching room was light and relatively flexible in use and arrangement. This department employed more workers than any other step in the process.

After the garments were completely sewed, they were pressed, folded, and packed into cardboard containers, which were labeled and placed in stock. The shipping room filled orders by withdrawals from the stockroom. There orders were assembled, packed in cartons, and dispatched for shipment by parcel post, express, or freight.

Having become convinced that sales of the coming year would be less than in any one of the preceding three years, the management of Humbolt-Clatson Company decided upon certain drastic changes in policy. Only changes in production are given here. Those included the following:

> Reduction of the product line by the elimination of all types of items that had not sold in volume during the past year. Approximately two-thirds of the items in the line were dropped. All items retained were made in the usual sizes demanded by the trade.
>
> Refusal of all special orders except those for models which appeared to be improvements on existing items and would probably replace them.
>
> Division of the year into two six-month production periods, one for the spring line and one for fall.
>
> Budgeting and detailed planning of each six months' production in advance.
>
> Manufacture for stock.
>
> Production at a steady rate throughout each period.
>
> Replacement of foremen with working bosses who spent most of their time at processing tasks. These working bosses were responsible for inspection of work in process.
>
> Elimination of three of the four clerks engaged in scheduling and cost work.
>
> Replacement of a job cost system with a simple cumulative daily statement for the manager. This statement showed daily production, payroll, orders, and shipments, with weekly summaries. Standard costs for raw materials and burden were developed.
>
> Repricing of overpriced piece-rate jobs at lower figures. Practically all workers had been paid piece rates.
>
> Closing of one finishing room.
>
> In all departments, operation of only the fastest and most modern equipment. Older, less efficient machines were stored in a manner to protect them from physical deterioration.

Handling of all operations by two executives: the president, who also served as sales manager, and the mill superintendent.

Results of the changes were reported for the following year as follows:

Budgeted sales, $275,000.
Actual sales, $254,000.
Practically no seasonal finished goods inventory at the end of either the spring or fall season.
Profit which, if continued, would wipe out all bank obligations within three years.
Lowest production cost ever attained by the company.
Lowest selling cost ever attained.
Production and selling savings of approximately equal amounts
Highest earnings workers had ever received from the company.
Best satisfied and most contented group of employees in the vicinity.
Best service ever rendered to customers.
Less effort required of the executives than for many years.

QUESTIONS

1. Explain how the action taken produced the results indicated.
2. Were the contraction policy and program of Humbolt-Clatson Company sound?

PROBLEM 17 WOODWORTH CITY TOOL COMPANY

The Woodworth City Tool Company made tools for use on metal-cutting machines. It sold its output to users of metalworking machines such as the automobile, household appliance, and electrical fixture industries. Its sales were subject to both seasonal and cyclical influences. The management was considering ways and means of stabilizing production.

The Woodworth Company made two lines of tools for manufacturers. Its cutting tools were used on milling machines, planer-type mills, and on automated, multiple-tooled, special-purpose machines such as those used to machine cylinder heads for automobile engines. All cutters were made to user specifications, usually for 8 to 12 weeks delivery. A small portion of this business consisted of repeat orders for designs produced to customer specifications in a prior season. The bulk of this business, however, differed from year to year as the user-manufacturers changed the designs of the products they made for consumer use.

Dies for use on sheet-metal cutting and drawing presses were made in a separate department fully equipped to produce this line of products. Like cutters, all dies were made to customer specifications which changed whenever the user changed its product specifications. In the automobile industry the bulk of these changes were made each year. In other industries alterations were somewhat less regular although for some time the trend had been in the direction of annual design change.

In addition to seasonal volume changes, Woodworth business reflected the ups and downs of the machine tool manufacturing industry. Manufacturers of milling machines, boring mills, and such did not buy from Woodworth. But whenever sales of machine tools were high, buyers of these machines increased their purchases of the cutting tools that were used on them. Fluctuations of cutting tool demand were not quite so severe as fluctuations in machine demand, but there was a high degree of correlation between the two. The accompanying table shows annual fluctuations in machine tool sales over a period of years.

Year	Increases over preceding year, per cent	Decreases from preceding year, per cent
1	40	
2	121	
3	76	
4	70	
5		11
6		58
7		15
8		23
9		8
10		6
11		14
12	23	
13	107	

The Woodworth City Tool Company did not make cutters of standard design and size. It always had catered to the special needs of manufacturers and over the years had built up a reputation for service and product reliability in this field. A large volume of cutters of standard design and sizes was required by industry. These were produced by manufacturers who sold their output through mill supply houses to small- and medium-size manufacturers. Some producers of standard cutters also sold direct to companies that used standard cutters in relatively large quantities.

The Woodworth Company never had produced standard cutters. Its equipment was not particularly adapted to this purpose. Although excellent standard cutters could be turned out on Woodworth equipment, the cost would tend to be somewhat higher. Manufacturers of standard cutters employed high-speed equipment with fixtures and tooling that made long production runs of nonvarying products economical.

Producers of standard cutters employed a small proportion of highly skilled labor. Most of their employees were semiskilled machine tenders. A large portion of Woodworth workers were skilled. The company had developed a policy of transferring workers from the die shop to the cutter shop (or the reverse) when demand fluctuations varied as between the two departments. Thus, over a period of years many Woodworth workers had developed two sets of skills. The ability to effect interdepartment transfer had helped to reduce the impact of volume fluctuation on the Woodworth work force, but this had been of no aid in lessening the effects of cyclical changes and was only helpful in a minor way in relieving seasonal impacts.

The table on page 196 shows the number of production workers employed by the Woodworth Company over a 36-month period and average hours worked per week.

Mr. George Barnes, production manager of the Woodworth City Tool Company, was constantly disturbed by the frequent hiring and layoff of workers that resulted from fluctuations in demand for the company's products. When workers were laid off, they sought employment elsewhere. Their skill always was in demand in the highly industrialized area in which Woodworth was located. Thus, when Barnes sought to rehire them when business picked up, he often found them unwilling to return to Woodworth. This necessitated the taking on of less skilled new workers and a training period which Barnes estimated to require from 12 to 24 weeks. During this time output of the new men was low and quality of their work below standard. Hiring and training not only increased direct labor costs but complicated

Year	Accounting period *	Average number of production employees	Average hours worked per week
1	5	58	40.0
	6	64	40.5
	7	69	40.5
	8	70	40.5
2	1	70	40.0
	2	81	45.0
	3	95	44.5
	4	96	46.0
	5	137	47.0
	6	156	45.0
	7	122	45.0
	8	119	45.0
3	1	139	45.5
	2	90	40.0
	3	123	40.0
	4	125	40.0
	5	126	40.0
	6	133	45.0
	7	119	44.5
	8	120	44.5
4	1	123	43.0
	2	114	42.5
	3	124	42.5
	4	140	42.5

* The company's calendar year was divided into eight accounting periods.

supervision problems and resulted in a relatively high fixed supervision cost.

Woodworth executives all were aware of this situation, but no solution to the problem had been found. Currently, activity in the company's plant was high, but executives of the company believed that this situation was likely to change shortly. Industry had been going through a period of rapid growth. There were indications that the expansion programs of many Woodworth customers were nearing completion. Characteristically, in the past, periods of capacity overexpansion had been followed by periods during which production capacity remained static until such time as consumer demand caught up with manufacturers' ability to produce. Woodworth managers foresaw a period of shrinking demand for cutting tools and dies.

After much executive discussion of this problem, Mr. Barnes made a proposal which he believed would relieve the company somewhat from the recurring problems of decrease and increase in size of work force. Mr. Barnes urged that the Woodworth Company go into the production of standard cutting tools. He proposed that the company produce these during times when demand for cutters and dies made to customer orders was low. Standard cutters would be made and stocked during these periods. When demand for specialized cutters and dies picked up, production of standard cutters would be curtailed. In periods of peak demand for special-order output, no standard cutters would be made. Essentially, standard cutter production would serve as a cushion to absorb production fluctuation.

Mr. Barnes recognized that his proposal would involve sizable investments in finished goods inventory. He realized that other problems would be encountered and that solutions for them would have to be developed. He believed, however, that gains would be worth the investment and the management effort involved.

Following are two skeleton balance sheets of the Woodworth City Tool Company. The first shows the situation at a time when the

Woodworth City Tool Company

Balance Sheet A

Figures in percentages. Total assets equal 100 per cent.

Cash	13.9%	Accounts Payable and Accrued Expenses	12.9%
Accounts Receivable	21.3	Notes Payable	17.5
Inventories—Raw Materials and Work in Process	25.0	Accrued Federal Income Taxes	11.2
Total Current Assets	60.2%	Total Current Liabilities	41.6%
Fixed Assets (Net)	35.0	Mortgage	11.4
Other Assets	4.8	Common Stock	11.6
		Surplus	35.4
Total	100.0%	Total	100.0%

Woodworth City Tool Company

Balance Sheet B

Figures in percentages. Total assets equal 100 per cent.

Cash	41.1%	Accounts Payable and Accrued Expenses	13.2%
Accounts Receivable	11.3	Notes Payable	6.0
Inventories—Raw Materials and Work in Process	8.0	Accrued Federal Income Taxes	8.3
Total Current Assets	60.4%	Total Current Liabilities	27.5%
Fixed Assets (Net)	34.5	Mortgage	17.1
Other Assets	5.1	Common Stock	17.4
		Surplus	38.0
Total	100.0%	Total	100.0%

company's activity was at a high level. The other shows conditions at a time when the company activity was at a combined seasonal and cyclical low. At the request of the Woodworth president these statements are presented here in the form of percentage of total assets.

QUESTIONS

1. Explicitly what gains might be expected if Mr. Barnes' recommendation were put into effect?
2. What competitive disadvantages should executives of the Woodworth City Tool Company anticipate if the company were to undertake the production and marketing of standard cutters?
3. State in such detail as you can the conditions you believe necessary to warrant favorable action on Mr. Barnes' proposal.

8

GROWTH AND STABILIZATION

1. GROWTH, A MANAGEMENT OBJECTIVE

Among the commonly recognized objectives of industrial managements is growth of the enterprise. In view of the dynamic nature of our society, this is to be expected. One might anticipate that under the circumstances large enterprises would constantly grow larger and that the rate of growth of these large industrial companies would be more rapid than the rate of growth of the economy as a whole. In the case of some companies this has been true; in other cases it has not. Comparison of the list of the 100 largest United States companies of today with a similar list 50 years ago shows many changes; old names have disappeared, and new ones have taken their place. Some of today's smaller companies will be among the greats of the future.

2. HOW COMPANIES GROW—HORIZONTAL EXPANSION

The ways by which company growth has been attained are many and varied. Some of these have been indicated in Chaps. 4 to 6. Probably the most common process of growth is expansion of production facilities to meet the demands of increasing sales effort. This expansion is secured by increasing the capacity of existing plant facilities, the building of additional plants, or the acquiring of ownership of facilities of competitive companies. This type of expansion contemplates no substantial change in product or product lines. Process changes reflect only the usual technical developments in the industry.

The decision to expand existing facilities or to add new units is influenced by such considerations as optimum size of producing unit, geographic aspects of market growth, availability of labor, organized labor pressures, and personal preferences of the executives.

3. NEW CONSTRUCTION VERSUS PURCHASE OF EXISTING FACILITIES

When the decision favors the addition of separate manufacturing units, management frequently has a choice between construction of modernized units and the acquisition of facilities from a competitor. The factors that were important in deciding on additional units will be influential in the choice between construction and purchasing. Additional considerations are the relative advantages and disadvantages of modernized processes as compared to older ones, time pressures for additional capacity, attitude of the Federal government, and Federal tax considerations.

Our government tends to frown on business moves that have, or are believed to have, the effect of reducing competition. This can become of major concern when one company is considering acquiring a competitor. Any exhaustive discussion of "antitrust" or "restraint of trade" is beyond the scope of this text. But awareness of this impact of government on business decisions is important.

Heavy Federal taxation of corporate profits has long been a matter of major concern. For some time it has been possible for a business to gain some relief from this burden by acquiring a company that has accumulated losses. Under certain conditions the past losses of the purchased business can be offset against the future profits of the buying corporation, thereby reducing the government's share of profits resulting from operations. Again, this is a subject of considerable complication with technicalities beyond the scope of our present study.

4. HORIZONTAL INTEGRATION

Expansion of the type we have thus far discussed has in the past been referred to by economists as "horizontal integration." Its characteristics include avoidance of increased product diversification, adherence to a common process, expansion of markets (often without change in distribution channels), and usually a relatively high degree of centralized management. Certain "natural monopolies" such as public utilities—the telephone is an example—and service producers, like the drive-yourself automobile renting companies, expand in this fashion. The same is true of many manufacturers of consumable products. The gains sought from horizontal integration are increased profits from expanded sales and benefits from large-scale production such as producing units of optimum size, more able management, and (up to a point) lower costs of management.

5. RESULTS OF HORIZONTAL INTEGRATION

Unfortunately (or perhaps fortunately) not all horizontal integrations have produced the expected results. Great size itself is not the key to low-cost production. Size not infrequently tends to make the problems of business management complicated, even unwieldy. Particularly this is true in the absence of careful specialization. Thus, horizontal integration is sound business policy when it tends to reduce production costs without saddling management with business problems of such ramifications as to render foresight difficult or lull management into a feeling of lethargic content in monopolistic advantage in this world of constant change. In substantial degree this failure to recognize the influences of change has been responsible for the disappearance of names from the periodic lists of the 100 largest businesses.

6. PROBLEMS OF FORESIGHT AND DATA PROCESSING

Foresight is becoming less difficult than it once was, and there are indications that this trend will continue. More pertinent information is available to today's executive than was the case even 20 years ago. The possibility of effective utilization of this information is enhanced by the more recent development of low-cost methods of processing large masses of quantitative information by means of high-speed electronic computers. Also our ability to quantify is on the increase. New units of measurement and systems of measurement are being developed rapidly. Pertinent mathematical theory is currently outracing our knowledge and skill of application. This is not to imply that we foresee a transistorized crystal ball that will eliminate all uncertainties of the future. But it now is clear that the manager of the next decade can have a wider range of alternative choice to which he will apply his experience, acquired judgment, and wisdom.

7. VERTICAL INTEGRATION—A GROWTH PROCESS

Expansion by "vertical integration" is a different type of growth process. Today it probably is less common than it was some decades ago. Whether this change is the result of the existence of fewer unexploited profitable opportunities or management realization of the risks and disadvantages of this type of growth is not known.

8. FORCES MAKING FOR VERTICAL INTEGRATION

The forces which from time to time have motivated managements to vertical integration policies often have been quite different from those which result in horizontal integration. The most common influence is a desire to eliminate the risks of dependence on suppliers of raw materials or fabricated parts or on outside channels for product distribution. To ensure uninterrupted flow of requisite materials, ownership of such sources is undertaken. To provide properly aggressive outflow of finished product, a distributing organization is acquired or built up to place the product in the hands of the consumer. When the urge to integrate grows out of the desire to avoid risks of this type, emphasis is upon maintenance of profits accruing from the original production activities of the business. The acquisition of dissimilar properties in the undertaking of new functions is essentially for the protection of the original purposes of the organization.

Vertical integrations have at times been motivated by the desire to supplement the profits of original functions by adding thereto the profits which others have enjoyed from the performance of facilitating functions. The reasoning involved is simple. The Ginwan Company makes a product that incorporates gray iron castings. During a period of years the output of this company has grown until the volume of gray iron castings required is great. Throughout this period the outside foundry from which the castings are procured has increased its profits just as the prosperity of the Ginwan Company has grown. Ginwan Company executives know this, and as competition narrows the margin between costs and profits on the machines they make and sell, the management looks somewhat covetously upon the profit the foundry makes from Ginwan Company castings. As a result, the Ginwan Company erects a foundry and makes its own gray iron castings. The company has embarked upon a program of vertical integration in an attempt at profit accretion. Continued pursuit of such a policy would involve the Ginwan Company in blast furnace operation to supply its foundry with pig iron, in the mining of coal and iron ore to provide the requisite raw materials for the blast furnace, and perhaps rail or water transportation from mine to furnace to foundry. These activities as here cited would be undertaken for the purposes of adding to Ginwan Company returns the profits from related though dissimilar activities.

It is not unknown for a company to pursue a vertical integration policy in furtherance of competitive price advantage in the market. Some years ago an automobile company with a venerable name in the manufacturing field advertised its product as "the one-profit car" produced by "the great independent." The idea behind such advertising lies in the implication that the company carries on many activities upon which it makes no profit. The advantage held out to the consumer is price reduction resulting from the manufacturer's selling a substantial part of the product at cost of production and distribution.

Manufacturers enjoying a market reputation for dependability and high quality of product occasionally embark upon a vertical integration program in an attempt to spread that quality reputation over a wider range of products. Almost no automobile manufacturer makes the storage batteries with which cars are equipped. In the past, however, at least one of the best known automobile trade names was placed upon batteries used by the company. The automobile manufacturer made these batteries, which undoubtedly received some popularity from the placing of the automobile manufacturer's name upon them. The brand was expected to extend to the battery the reputation for quality enjoyed by the automobile itself.

9. STRENGTH AND WEAKNESS OF VERTICAL INTEGRATION

Probably more attempts at profit increase by means of vertical integration have failed than have succeeded. As has been noted, the objectives sought through such activity are varied and include control of materials supply, ensurance of market channels, finished product price advantage, and enhancement of quality reputation. Lack of success is not peculiar to any one of these, although the case for vertical integration may well be stronger with certain objectives in mind than with others.

Ownership of sources is no panacea for the elimination of risks of raw materials and parts supply. The company which embarks upon a program of materials or parts production actually exchanges one group of risks for another. Commonly the processes and problems of materials production are quite unlike those with which the integrating company is familiar. The risks of inefficient raw materials production are undoubtedly greater when an inexperienced manufacturer undertakes their production. The major advantage enjoyed by a materials producer when owned and controlled by its product user is assurance of demand for at least part of its output. This market backlog often does not eliminate, however, the need for developing other outlets in competition with experienced producers in the field. It is not to be expected that optimum size of a materials producing unit will usually coincide with the materials requirements of the parent company. Thus, more often than not, the materials producing unit is subject to disadvantages of uneconomical size from a production standpoint, or must actively undertake competitive marketing of a portion of its output.

Integration in the direction of raw materials production increases in number and complicates in nature the problems of management. Attention of executives usually must be divided between activities of quite unlike nature. This dilution may have an unfortunate effect upon the affairs of the parent company. To whatever extent the raw materials supply problems of the integrating company are relieved by such action, the increase in management difficulties is somewhat offset.

More often than not it is a mistake to think that satisfactory control of materials requirements cannot be attained through buying in the open market. Active market competition is an effective safeguard to the buyer in most cases. Stability of supply can usually be increased through the establishment of close relations with a small number of carefully selected suppliers. Essentially, what was said at the beginning of this discussion serves well to summarize it. Vertical integration to secure control of raw materials and parts supply is basically a situation in which management attempts to relieve itself of one set of risks by accepting another set of dissimilar risks. Occasionally, this decision is a display of wisdom. All too frequently management is ill equipped to cope with the new problems undertaken, and the result is cost of materials in excess of market price plus the cost of procurement.

To the extent that there is soundness in our analysis of weakness of materials production to ensure supply control, there is danger in the vertical integration program undertaken to add to profits accruing from established activity. Much of American industry is highly specialized industry. There are specialized producers of watch and clock hands, of valve guides for automobile engines, of the vacuum tubes with which radios are equipped, of wooden chair legs, and of thousands of the parts that go into the simplest and the most complicated things we use in everyday life. These specialist producers have developed great efficiency as communication and transportation have become lightning-fast and gravity-sure in a great economic area unhampered by man-made trade restrictions. Likewise, technical progress has been driving manufacturing executives into narrower lines of activity through constant acceleration in the rate of change.

For the Ginwan Company management to assume that it could make a profit from the operation of its own foundry just because the company from which it had been buying castings had made a profit would be a serious mistake. Perhaps profits would result; perhaps losses would be entailed. A hundred conditions might be effective determinants. Suppose the Ginwan Company is subject to severe seasonal fluctuations in its volume. In that case its foundry operation might be highly intermittent. Nonconstant operation is costly operation. The merchant foundry from which Ginwan Company has purchased parts need not be subject to this adverse seasonal effect, for it can balance the seasonal Ginwan demand with business solicited from sources with demand peaks offsetting those of the Ginwan Company. If the latter company is to produce castings as cheaply as the merchant foundry, it must take steps to meet this disadvantage of its own seasonal operation. It might make castings for stock, but that would involve inventory costs to which the Ginwan Company is not now subject. Furthermore, it would accept the risks of inventory obsolescence, which it now escapes. If production for stock was unwise, about the only way open for Ginwan Company to obtain basic efficiency parity with the merchant foundry would be to obtain outside business during the seasons when its own demand was slack. This might be easy, or it might be almost impossible. To assume that no problem is involved certainly would be a fundamental mistake.

Seasonal variation is only one of many possible difficulties that the Ginwan Company management might encounter. The specialized materials and parts producer has become dominant in American industry largely because he possesses real economic advantage. There are occasions when these specialists do not have a net advantage, but more often than not they do. Any notion that the existence of profits in the business of materials and parts supply offers an opportunity to the buyer to obtain those profits for himself simply by undertaking production of such materials and parts is gross error. There are occasions upon which the manufacturer can increase his profit by vertically extending the area of his activity. To determine when these occasions actually exist and when vertical integration would be unprofitable is a management problem of considerable magnitude.

Obviously, if vertical integration results in uneconomical production, the management which seeks price advantage through such activity is headed for disappointment. No more need be said on that matter. The one-profit-product notion, though closely related, is slightly different. If it is assumed that the integrating company can carry on the diverse affiliated activities exactly as economically as they were carried on prior to integration, the ability thereby to pass on to the consumer the profits of the nonintegrated producers is questionable. There is little to indicate that integration of these activities will result in reduction of capital essential to the conduct of the affiliated enterprise. The suppliers of such capital, whether they are stockholders of the parent company or not, will expect, and in the long run insist upon, a return on their investment commensurate with the amount of the commitment and the risk involved. It has just been pointed out that there is little likelihood that either the amount of capital required or the risk entailed inevitably will be lessened by vertical integration. It would seem, then, that only to the extent that the nonintegrated unit had been able to return an abnormally liberal profit through exceptional efficiency would it be possible to reduce the capital costs of production through integration. The more efficient the production has been in the past, the more difficult the job of making integrated production successful, and, thus, the less the likelihood that new management can maintain the past profit level. The one-profit-product idea may be good advertising. On rare occasions it will certainly have basis in fact. That, however, will be the exception.

The advantages likely to result from vertical integration in the interest of extending brand values depend on marketing considerations that are essentially outside the immediate concern of this text. No such marketing program should be undertaken, however, without careful study of the production problems involved. Many production problems inherent in vertical integration have already been discussed or pointed out, and these must be satisfactorily settled if any market advantages are to be net advantages, not offset by production difficulties or inefficiencies.

10. DIVERSIFIED EXPANSION TO STABILIZE PRODUCTION OR SELLING

Combination sometimes has its origin in the desire to eliminate costly characteristics of either a production or a marketing situation. The most common condition from which relief is sought by combining the production of seemingly dissimilar products in one plant is seasonal demand. When the nature of a highly seasonal product is such that a specialized marketing organization is required for its distribution, marketing costs are likely to be excessive. If a product of like nature (in the sense of marketing organization requirements) but with offsetting seasonal peaks and lows could be made available to the sales organization, distribution costs should thereby become much more nearly normal. The addition of such a product would involve either manufacture or purchase outside for resale. If conditions seem to indicate the desirability of manufacture, the problem of integration immediately becomes pertinent. It would be purely fortuitous if the addition of the new product to the one already manufactured resulted in production economies. If the process, materials, and labor requirements are essentially unlike those being employed, the result is likely to be an increase in existing costs. If the opposite is true and basic likenesses exist, the resulting ability to eliminate seasonal hiring and firing and periodic idleness of equipment and supervisory personnel should bring about lowered cost of production of the line already produced and low cost of production of the added product.

The economies of production under such circumstances may be so substantial as to dictate integration even though no marketing advantages result. While the two products involved may be basically complementary as to production characteristics, from the standpoint of marketing they may have widely different characteristics. Under such circumstances it is imperative to make sure that the increase in marketing costs does not wipe out production economies gained. Likewise, when seasonally complementary products will reduce selling costs, it is important to make certain that production costs will not increase to such an extent as to eliminate market gains. The most fortunate of circumstances is, of course, a situation in which two products are seasonally complementary in both marketing and production.

While seasonality is the most common cause of diversified integration, it is not the only one. Whatever the urge may be, the same need for considering both the market and the production aspects of the situation exists. The difference between success and failure is managerial consideration of the problem as a business issue rather than from a more exclusive viewpoint of technical production or marketing. The two technical aspects are important, but the businesslike reconciliation of the two is absolutely essential to success.

11. GROWTH FROM INTEGRATION

In spite of the somewhat drab picture which has been painted here of the dangers and pitfalls of expansion, anyone who will read that part of the industrial history of the United States which covers the last half of the nineteenth century and the first half of the twentieth cannot fail to be impressed by the ever-present movement toward growth. A study of the size of the average manufacturing establishment since 1850 shows clearly what has taken place in American industry. Large organizations are the order of the day. In some industries, such as iron and steel and meat packing, although the value of the product and the number of workers employed have increased tremendously since the early 1880's, the number of producing establishments has either remained practically stationary or actually decreased. The influences which have been responsible for this are financial, marketing, managerial, and production economies. The particular advantages that will be outstanding in any given case will, of course, depend entirely on the circumstances surrounding the expansion. Sometimes the most obvious gains will come because of some new method of distribution. In other cases, financial benefits are outstanding; in still others, managerial and production gains are most important. It should be emphasized, however, that financial reorganizations which are not in the last analysis based upon sound economies in marketing, management, and production may be the cause of profound industrial disturbances.

One can conclude the whole subject of growth by the more or less obvious statement that if expansion occurs intelligently and for the best interests of society, as well as for those of the manufacturer, its benefits are outstanding. Where, however, products which are not naturally complementary in nature are integrated, or where the ultimate object is financial manipulation or monopoly rather than the legitimate advantages of mass production, then the result may easily spell disaster and eventually ruin. Just how far business units should be allowed to expand in order to gain the benefits of mass production is one of the most baffling of all questions which the American people face today.

12. EXPANSION DURING AND SINCE THE SECOND WORLD WAR

One of the most serious problems of the manufacturer during and following wars has been the obtaining of adequate raw materials. Government wartime control of materials through the use of priority allocations has limited materials for nonmilitary use to a small fraction of prewar volume. In attempts to bolster these inadequate supplies, many manufacturers purchased mills that produced the raw materials they required. Users of cotton cloth such as the larger manufacturers of men's and women's clothing purchased spinning and weaving mills. Much of the output of such a "captured" mill went to the government, but whatever was left over was available to the garment manufacturer who had the cloth finished for his use by custom bleacheries and printworks. Many of these mills were old and inefficient, and the purchasers often paid two or three times their prewar market worth. However, these mills did provide the garment manufacturers with some cloth when none was available from their usual source, the piece goods market.

Whenever a garment manufacturer purchased a cotton mill, a certain amount of fabric which regularly had gone from that mill to converters was no longer available to those business houses. Converters regularly bought gray goods from mills, had them finished and dyed, and then sold them to garment manufacturers. To protect their position in the market, some converters purchased cotton mills, and to ensure finishing capacity also they likewise bought bleacheries and printworks. Sometimes cotton mill owners enviously eyeing profits that were being made by finishers and converters stepped out and acquired their own bleacheries and printworks. The result of all this was a new structure within a substantial part of the raw-cotton-to-finished-garment industry. Over many past years this old, established industry had reacted to the influences of the techniques and economics of the business and had developed a highly specialized structure. This consisted of independently owned and operated gray goods mills, finishing plants, converting houses, and consumer products manufacturers. There were only a few instances where vertical integration had worked well. These were producers of standardized nonstyle products, such as sheets and pillow cases, gauze bandages, and the like. Pequot sheets and the Kendall Company's products are examples. Attempts to integrate from cotton to garment had never worked out well when any substantial style element was involved, and management in the industry had come to believe that independent specialized producers at the various steps in the process constituted sound organization for the industry.

When wartime controls of materials were removed, competition for cotton goods by garment manufacturers increased because of the need to get back quickly into the civilian market. The trade journals reported more mill purchases, and again the motive was the securing of needed materials. Exactly how long this integration will last is difficult to foresee, but insofar as style goods are concerned it has disappeared.

This wartime and postwar story has been told here at some length to illustrate the impact of the dynamics of society on one of industry's expansion practices, vertical integration. A temporary drastic change in the industrial scene called for a basic change in operating policy. The management that recognized early this need for change and acted on it profited from foresight. Likewise, managements that have recognized the writing on the wall as the situation again has changed and have had the judgment and fortitude to change with the times again have profited.

Other examples of war-born vertical integration can be cited. Just so long as these combinations are harmonious with existing industrial conditions, they can be sound. Managements of such combinations must be alert to changes and shifts in the related industries concerned. They should be as quick to undo that which they have done as they were in originally promoting the integrations.

13. FINANCIAL CAUSES OF DIVERSIFIED EXPANSION

Following the cessation of the Korean hostilities, a number of manufacturers found themselves with large cash resources. When it seemed that this liquid capital could not be used effectively by expanding, the business management was faced with the serious problem of its disposition. If it was paid out in dividends to stockholders the return to the proprietors would be reduced very substantially by Federal and state personal income taxes. One alternative seemed to be to buy other businesses. This use was particularly attractive when the excess capital was held by businesses whose rate of future growth was expected to be slow. Under these circumstances there was great temptation to buy rapidly growing businesses with unusual possibilities of future expansion. Such businesses usually were totally unlike the businesses that acquired them. Their marketing problems were different. Their production processes were entirely different. Their research needs and programs were unique. Thus, their management called for skills not possessed by the purchasing business organizations.

In a rather surprising number of instances these purchases of completely unlike businesses have thus far been successful. When this has occurred, it most often has been the result of careful appraisal of the operating situation by the management of the purchasing company. These perceptive executives have recognized their own lacks for successfully managing the acquired companies. They have retained the specialized skills of the managers of the companies purchased and have restricted themselves to financial and business guidance of their new acquisitions. To what extent these successes have been "underwritten" by the fact that the acquired companies are in a stage of rapid growth (usually in new or growing industries) is impossible to say. It is clear, however, that these successes are not an argument for expansion by means of vertical integration where the growth element is not existent.

There have been well-recognized failures by some companies that have used excess funds to purchase unfamiliar kinds of business. These failures frequently can be traced to the attempts of purchasing managements to "take over" and run these new acquisitions in the pattern of their past experience, an experience that ill equipped these managers to meet their new problems. When such failures have occurred. the stockholders of the buying companies have been the losers.

14. MANAGEMENT'S RESPONSIBILITY FOR RETAINED FUNDS

This is a clear example of management's need to recognize in full its responsibility to its stockholders. All managements recognize this responsibility insofar as profits and dividends are concerned. Recognition of responsibility for retaining earnings in the business and for use and disposition of such retained earnings is not so universally recognized. Earnings are the result of use of stockholders' contributions. Retaining earnings deprives stockholders of alternative uses of these funds. Thus, the decision to retain earnings and invest them in expansion of existing facilities or in other business activities is an act for which managers properly can be held accountable.

15. DIVERSIFIED EXPANSION AROUND A COMMON CONCEPT

These postwar aggregations of dissimilar businesses should not be confused with the long-term activities of a few large United States corporations which on the surface might seem to be of similar character. Westinghouse and General Electric are typical of a very small number of corporations that manufacture a wide, wide range of dissimilar industrial and consumer products. For example, there is little similarity between a huge hydroelectric generator, a Christmas-tree light, and a high-fidelity record player either as products or as to the processes and facilities required for their manufacture. But they share one characteristic in common: they either are generators of or users of electric current. The relation of some of General Electric's hundreds of products to electric power is less obvious. But items such as synthetic kitchen counter tops are closely related to certain insulating materials critical to power using equipment and indirectly can be traced to the basic core interest in power generating and using products.

This consistency can be approached from another angle. The success and growth of Westinghouse and General Electric have their roots in research. Much of this research has always been so-called pure research. This is search for new knowledge for the sake of new knowledge itself. Behind this is faith in the ability of applied researchers and product developers eventually to make applications of new knowledge. These companies long have enjoyed a reputation for product leadership, and "Progress is our most important product" is much more than an apt advertising slogan. Pure research and its application development will inevitably over years produce unexpected product opportunities, some of them with little relationship to power production and usage. But in the main, both of these widely diversified companies have confined their manufacturing activities to products closely allied to the core concept, electric energy. The most serious operating problems these companies face is a supply of managers capable of handling major responsibilities. Top executives of both corporations maintain that this is their size-limiting factor. A large volume could be written on the means such companies employ to overcome their size handicaps and to remain outstanding competitors in the varied industries within which they operate. But these companies are exceptions. Attention is directed to them here simply to emphasize what has been said about the usual situations.

16. GROWTH AND OPTIMUM SIZE

Growth is a major goal of most modern businesses in our ever-dynamic society. Usually it is considered essential to perpetuation of the unit and its profits. But as we saw earlier in our discussions, just what constitutes mass in modern mass production runs a wide range quantitatively. Optimum size is a resultant of the many factors and functions in the modern manufacturing unit.

QUESTIONS

1. Explain how growth and profits as management objectives are related.
2. What differentiates horizontal expansion from other types of business expansion?
3. Explain the strengths and the weaknesses of horizontal integration.
4. "In some ways the increasing ability to quantify and process information will make decision making at the business executive level easier; in some ways it will make decision making more difficult." Explain in what ways this statement is accurate.
5. How does vertical integration differ from other types of expansion?
6. What are the risks involved in a vertical integration program? Under what circumstances is this type of expansion most likely to be appropriate?
7. What lessons are to be learned for the wartime expansion experiences described in this chapter?
8. Please be prepared to discuss and evaluate management's responsibilities for growth of an enterprise.
9. Insofar as you can identify them, what are the strengths and what

are the weaknesses of an enterprise such as the General Electric Company?

10. What organizational problems would you anticipate that the General Electric Company has encountered during the years of its growth and expansion?

PROBLEM 18 JENKINS AIR-WELD COMPANY

The Jenkins Air-Weld Company was a "war baby." After its conversion to peacetime production, it found itself facing problems characteristic of seasonal product demand. In an attempt to remedy this situation, executives of the company were looking for "complementary" products.

The Jenkins Air-Weld Company was organized during a war emergency to make welded tubular frames for the government. At first these frames were made for the Quartermaster Department of the Army. The company expanded rapidly and soon was making a wide variety of tubular frames used for many different purposes by other Army departments and by the Navy and Air Force as well. All items were made to buyer specification for military use.

When the war ended the company experienced a difficult period of adjustment to civilian production. Eventually it established itself as the manufacturer of a line of high-quality, high-priced electric fans with certain patented features that were responsible for the unusually high efficiency of the product.

Demand for electric fans was seasonal. The company met this situation by reducing its work force during the late summer, fall, and early winter months. During this slack period it built a substantial inventory of finished product.

All fans made by the company had welded tubular frames on which were mounted a series of sheet-metal baffles which controlled the movement of air as it was pulled into the fan by a propeller-type blade mounted on the shaft of a small electric motor. Another series of adjustable sheet-metal baffles performed similar functions for the air as it left the fan. The company made the tubular frame and the sheet-metal parts, including the fan blades. It purchased the motor and the control switch. Most of the assembly was accomplished by welding. An average of 1.45 hours of direct labor was required for the production of one fan.

Company executives sought a product or products that would reduce the seasonal disadvantages inherent in its fan line. Typical of the items considered were two types of electric room heaters and a comparable gas-fired room heater. At the time the Jenkins Air-Weld Company was considering making these three products, none of them had been introduced in the American market. Two of them were in home use in England, and one of the electric heaters had never been manufactured anywhere. Following is a brief description of the three products.

The electric heater that had been introduced to the English market earlier consisted of a portable electric fan with an electric heating unit mounted in front of the fan. If the Jenkins company made this heater, it would purchase the heating element and its ceramic mountings from one of a number of electrical-parts manufacturers. Only slight modifications of the present fan design would be required to accommodate the heating element. It would not be possible to obtain patents on the heating features of this product. Jenkins company executives believed there would be a market for these combination electric heaters and fans. Their major handicap in the market was believed to be their relatively high cost of operation as a heating device in areas where the cost of electric current was high.

The other electric heater was an entirely new product. It operated on a completely different principle and was expected to have the virtue of relatively low operating cost. This heater consisted of a glass panel which radiated heat when an electric current was applied to it. The heating panel was patented, and the Jenkins company would have to purchase panels from the manufacturing company that owned the patent. The Jenkins Air-Weld Company would make a welded tubular frame which would hold the panel in a vertical position and constitute a housing for the heating element. Company engineers made a careful study of the operations involved in the making and assembly of the parts of this heater and reported that the company should be able to do this work at an average of less than 0.67 man-hour of direct labor per heater. Total cost of production was expected to be about 125 per cent of the average cost of making the combination fan-and-heater unit. Company sales executives believed that the product would sell at about 25 per cent more that the combination unit but were unwilling to estimate what total volume might reasonably be expected. They emphasized that the two electric heaters were not entirely comparable products.

The production engineers pointed out that the panel heater would require about $15,000 expenditure for jigs and fixtures for its manufacture. No comparable expenditure would be involved in preparing to manufacture the combination fan and heater. At a conference at which time the panel heater was under discussion, the company president stated that the owner of the panel patent was willing to give the first company to undertake the manufacture of this type of radiant heater exclusive use of the patented element for two years. After that time it would license any other manufacturers it thought advisable.

The third room heater under consideration was a small cast-iron and sheet-metal grill in which was supported an upright ceramic panel. The panel was hollow with small apertures on its face. Gas flowed into the panel, emerged through the small apertures, and burned at those points. This heater was both attractive and economical in operation. The unique feature of this heater was its use of a bottled gas which made it entirely portable and eliminated all costs of installation. The product had been a complete success in England, where three competing manufacturers had combined to arrange for convenient availability of the small containers of the bottled gas which was the fuel used. This gas was sold in quantity in the United States in large metal "bottles" for use in cooking ranges, but no distribution in suitable small containers existed.

Engineering studies of this product indicated an average direct-labor requirement of 2.15 hours per unit. This figure would be reduced somewhat when volume increased, because over half the direct labor time would be expended in the machining of cast parts. The Jenkins company had no foundry and would have to purchase castings and the ceramic burner plate. The cost of these would be less than one-half the current purchase price of the electric motors used by the company in its fans.

To make this heater the company would have to buy about $52,000 worth of machine tools, all of a type that it did not own.

QUESTIONS

1. What, if any, of the three products would you recommend that the Jenkins Air-Weld Company manufacture?
2. Would this be an example of integration? Explain.

PROBLEM 19 SANTOS LA PANTA MINES

The Brainbridge Mining and Smelting Company owned and operated gold mines in many parts of the world. Among its holdings was a Philippine company, the Santos La Panta Mines. Profits from this operation were unsatisfactory, and company executives frequently had considered closing the mines and discontinuing its Philippine operations.

The Santos La Panta properties of the Brainbridge Mining and Smelting Company consisted of three gold mines located along a mountain ridge in the northern part of the Philippine island of Luzon. There were six gold mines scattered along a 12-mile stretch of the eastern slope of this ridge and two mines on the western slope. Two of the six mines on the eastern side of the ridge were owned and operated by Santos La Panta Mines, a Philippine corporation. Directly across the ridge to the west were two other mines. Santos La Panta owned and operated one of these mines.

All the mines in the La Panta area were old. They had been discovered and originally worked by the Spanish when they occupied the islands. During the years when the Philippines had belonged to the United States, ownership of the eight mines in the La Panta area was transferred to Filipino interests. The Brainbridge Mining and Smelting Company had organized the Santos La Panta Mines company, which purchased three of the eight mines. The Brainbridge company owned 90 per cent of the common stock of Santos La Panta Mines; the remaining 10 per cent was owned by a Manila church organization.

The gold mines along the La Panta ridge had been operated continuously since the days of their discovery. Originally the deposits had been rich, but as operations continued the ores became less and less rich. Although there was some variation in the ores of the several mines, none of them currently was a substantial profit producer.

Profits from La Panta mines were determined by cost of production and amount of government subsidy. All gold output was sold to the government at a government determined price. Gold was important to the Philippine government as a means of obtaining foreign exchange. The government paid Philippine pesos for the gold and could sell it for dollars, sterling, or whatever currency it needed. The price which the government was willing to pay for gold thus was influenced by its needs for foreign exchange. Since the country achieved its independence, this need for foreign currencies had been continuous and on the increase.

The fact that the government wished the La Panta (and other) gold mines to continue operations was indicated by action taken to assure the La Panta mines of an adequate supply of timber for use in their operations. As the forested areas close by the mines became depleted, the mining companies experienced a steady increase in timber prices. In part this was the result of increasing transportation costs. More important was the competition of lumber firms that cut timber for export. The resulting increase in mining costs caused the government to ban export of timber from the forested areas most accessible to the La Panta area gold mines.

How long the Philippine government would be willing to pay a relatively high price for locally mined gold was uncertain. The condition of the country's economy was such as to indicate that the government would seek locally mined gold for a considerable time, probably a minimum of 10 years.

The Santos La Panta Mines properties were designated as Santos Number 1, Santos Number 2, and Santos Number 3. Santos Number 1 was the last mine to the north of the six mines on the eastern slope of the ridge. It was separated from Santos Number 2 by two mines, one owned and operated by Filipinos Consolidated, the other by the Cosarios Brothers, Inc. Ore from Santos Number 1 was crushed at the mine and then trucked to Santos Number 2 to be smelted. Although the two mine entrances were only 3 miles apart, the mountainous nature of the terrain necessitated a 14-mile motor haul. Santos Number 3 was directly across the ridge west of Santos Number 2, an airline distance of less than 2 miles. Ore from Santos Number 3 was crushed and smelted at the mine. A 28-mile private road connected the two mines, but the cost of maintaining this road for ore transportation by truck was prohibitive. Animal pack trains over this mountain road were used to transport gold from the Santos Number 3 smelter to Santos Number 2 for transshipment to Manila.

Santos Number 3 crushed and smelted the output of the other mine on the western slope of the La Panta ridge. This mine was owned by a church order with headquarters in Manila. Although it was costly to keep the ores from these two mines separated during the crushing and smelting processes, the use of a single crushing and smelting installation was advantageous to both companies. However, the combined requirement of the two mines was not sufficient to keep the crushing and smelting facility on the western slope of the ridge economically occupied. Both the crushing and smelting equipments of this installation were small and because of this were costly to operate.

The smelter at Santos Number 2 was larger. It not only smelted ores from Santos Number 2 and Santos Number 1; it also smelted the ores from all the other eastern slope mines. Each of these mines did its own crushing and trucked the ore over a jointly maintained road to the smelter at Santos Number 2. Had it not been for the complications resulting from keeping the runs from these other mines separated, the smelter at Santos Number 2 would have been an economical operation because of its size. Still it had some unused capacity. If it had discontinued smelting for other than the Santos La Panta mines its costs would have increased substantially.

No two contiguous mines of the eight operating on the two sides of the La Panta ridge were owned or operated by the same company. As a result each maintained its own engineering staff, timber crew, safety crew, employment office, ventilation and hoisting equipment, and other specialized services essential to its activity. No mine was large enough to keep these services continuously busy.

As mining operations penetrated deeper and deeper into the mountain, underground ore haulage distances increased. At many points the tunnels of one mine would approach those of another with not more than a few hundred feet separating them. Each company was required to maintain at least two exit shafts from its mine. Because of the same government regulation one company could not break through the barriers into an adjacent mine operated by another company. Had it not been for this ownership separation the mines could have been connected physically, and ore could have been moved underground to the nearest exit tunnel. Many of the exit tunnels would have been unnecessary and could have been closed.

All mines shipped their gold to Manila by helicopter. A small landing field had been constructed near Santos Number 2, and a shipment of gold bars was made once each week.

When the gold bars reached Manila, they were taken directly to the central bank. The mining companies were required to turn all gold mined over to the central government. The government subsidized gold production by paying a price slightly above the cost of production. As the mines became less and less productive and their costs increased, the margin between cost and price narrowed. Santos La Panta was in a somewhat better position than the other mining companies because its ores still were somewhat richer than those of its neighbors. Still its profits measured in terms of capital invested were low as compared to other Brainbridge Mining and Smelting Company activities.

At a meeting of Brainbridge's board of directors in New York the Santos La Panta problem was under discussion. It was agreed that the Santos mines should continue to operate as long as they showed any profits. When it was pointed out that the other operations on the La Panta ridge were feeling the cost-price pinch more severely than Santos, it was suggested that it might be possible to buy these properties at an attractive price. It was decided to send Brainbridge engineers to the Philippines to make a careful study of the advisability of acquiring the two mines between Santos Number 1 and Santos Number 2 and the one unowned mine on the western slope. This group also was instructed to determine the cost of promptly breaking through the estimated one-quarter mile barrier that was believed to separate Santos Number 3 from Santos Number 2.

QUESTIONS

1. What specific facts should Brainbridge engineers obtain and what aspects of the situation should they study?
2. Why should Brainbridge executives consider the purchase of relatively high-cost producing mines on the La Panta ridge?
3. Is the proposition under consideration an integration? Please be prepared to explain.
4. Was the conclusion not to shut down the Santos mines sound?

PART 2

THE FACTORS OF PRODUCTION

9

RAW MATERIALS PROCUREMENT

KINGSLEY SHOE COMPANY (B)

1. A TYPICAL EXAMPLE OF RAW MATERIALS SUPPLY AND PURCHASING PROBLEMS

In an effort to obtain better control of its purchasing activities the management of the Kingsley Shoe Company placed responsibility for most of the company's raw materials and manufacturing supplies procurement with one executive. This official adopted as a general policy the plan of purchasing on a routine basis. He found that for most supplies and materials this policy worked well. In buying linen thread, however, conditions caused him to depart from his established policy. This departure from his general program was only partially successful, and the purchasing officer was convinced that this would be a recurring problem. He sought means of making the use of linen thread unnecessary.

2. FACTORS OF PRODUCTION

In explaining the operations of our present industrial organization, classical economists have pointed out four fundamental factors of production: land, capital, labor, and enterprise. The business manager works with these same four agents although the terminology he uses in referring to them is usually different from that employed by the economist. The equivalent of land, he refers to as raw materials. Capital is spoken of in terms of plant, building, and equipment, or working capital. Labor is often called personnel. Enterprise is known as management.

3. NATURE OF MANAGEMENT'S PROBLEMS

In Chap. 2 we pointed out that the business executive in performing his function as a manager serves his company as a problem solver. Essentially his problem is to control the three other factors of production to the end that they may be united to form an effective producing unit. This requires the formation and putting into effect of definite policies of managerial control. In other words, management involves the creation of the proper relationships between the production factors of a business unit within an industry and the maintenance of those relationships in terms of changing conditions.

The popular picture of a high-salaried American executive as a man who sits at his desk simultaneously dictating to a stenographer, talking over the telephone, pressing electric buzzers, and listening to words of advice from his private secretary is something more than a caricature of what is actually taking place. Every day the manager faces the task of coordinating and maintaining proper relationships within his business unit. Externally these relationships concern the competitive position of his unit in the industry of which it is a part. Internally the relationships are associated with the proper correlation of plant, buildings and equipment, raw materials, and personnel, all of which are conditioned by highly dynamic surroundings. An unexpected stoppage in source of raw materials supply, for example, may easily throw normal relationships out of adjustment to such an extent as to paralyze temporarily the functioning of the plant. One of the manager's many duties is to see that a condition of this kind does not arise.

4. SCOPE OF THE PURCHASING FUNCTION

The chapters which follow are an analysis of various means by which executives exert managerial control so as to maintain relationships on as nearly normal a basis as possible.

Just as the economist considers land indispensable if goods are to be produced, so too the modern manager looks upon a supply of raw materials as essential. The executive in charge of purchasing must know his sources of raw materials, foreign and domestic, potential as well as actual. He must be able to characterize a given choice of supply in respect to quality, service, and price, and do so in terms of the specific needs of his business. In short, he must know what to purchase, where to purchase, when to purchase, how to purchase, how much to purchase, and how much to pay.

5. HOW THE SMALL BUSINESS BUYS

As a business grows in size, more attention is commonly given to purchasing. Up to the point where the time necessary to do the buying is sufficient to absorb all the energies of one person, one of two methods of getting the purchasing job done usually is followed. Frequently an officer of the company does the buying as one of his several duties. That officer may be the president of the company, the general manager in charge of both production and selling, the plant manager charged with manufacturing operations, the company treasurer, the office manager, or even the head foreman out in the shop. In the slipper manufacturing business occasionally the sales managers of small shops buy the necessary supplies of leather, fabrics, and findings in addition to their responsibility for selling the products of the shops. Where the business is small, almost any officer of the company may have as one of his duties the purchase of required raw materials and supplies.

Another situation often found in a small business is decentralization of the purchasing job. The office manager, treasurer, or head bookkeeper buys the stationery and similar supplies required for the office. In the shop each foreman buys the materials used in his department. Maintenance and repair supplies are purchased by whatever man has the maintenance job. Each responsible individual buys what he needs when he thinks he needs it, where it seems to him best, subject only to the general or specific approval of his immediate superior. Under such conditions suppliers usually know the company and its customary methods, honor the requisitions with which the various buying individuals are armed, and bill the company periodically. The financial relationships of buying are usually arranged by the treasurer or head bookkeeper under such circumstances. When so decentralized, purchasing will obviously be subjected to much looseness of control and will be restricted to local suppliers.

6. HOW THE LARGER BUSINESS PURCHASES

Even in businesses of substantial size, buying is frequently decentralized to some degree. It is quite common for the office manager to buy the stationery, forms, and office supplies for the entire plant as well as for his own office. The superintendent or foreman in charge of maintenance and repairs often will buy the materials and supplies needed by his department. This is particularly true of repair items which are infrequently required and not commonly carried in stock. Purchases for the machining departments often are made by a clerical assistant of the machine shop foreman, and the foundry superintendent may buy the sand he uses.

While such decentralization is frequently found in manufacturing units of substantial size, the trend with growth is toward centralization.

One individual is made responsible for providing all materials and supplies required. Buying is his major task, and he spends all or most of his time at it. Because of past experience and the specific nature of the supplies required, the office manager may buy his own requirements even after all other materials purchases have become the responsibility of some one man. Sooner or later, however, he is likely to go the common way and pass on to the purchasing agent the job of buying office supplies. This centralization of authority for the performance of the purchasing function has disadvantages as well as advantages.

7. SPECIALIZATION WITHIN THE PURCHASING ORGANIZATION

There comes a time with the growing business when one man can no longer do the entire purchasing job. The task becomes too big and he has to have assistance. Usually the organization which develops is based upon functional specialization. Contact with suppliers and salesmen is made a separate job. The routines of handling shop requisitions and placement of orders are specialized. The work of the department is broken up on a functional basis.

Departures are sometimes made from this type of organization. Cotton textile mills usually have one man who buys nothing but raw cotton, other requirements being procured by a general purchasing executive. A shoe factory is quite likely to have an executive whose sole job is the purchase of upper leather. A soap or cooking compound manufacturer may well have a specialist buyer of vegetable oils. In such cases the raw material so purchased is usually needed in large volume. Frequently its cost is a large part of the total cost of manufacture. Also the organization of the market in which the material is bought may be of such complexity as to call for expert knowledge and constant careful attention to change in market supply and demand. Such situations require specialists and give rise to departures from the more usual method of subdividing the work of the purchasing department.

When the volume of purchases is great and the procurement requirements are varied, a combination of specialization by function and specialization by commodity or product purchased is the rule. This type of organization is usually found in the purchasing departments of large institutions such as universities and hospitals. One person specializes on the purchase of food, another on the purchase of chemical laboratory supplies. One person buys electronic apparatus, and still another will purchase such items as coal or fuel oil, linen, paints, and the like. These "buyers" spend all their time in contacts with suppliers and their salesmen in developing new sources of supply, in constantly familiarizing themselves with new developments in their specialized areas. At the same time, functional specialists prepare orders from requisitions and handle the routines of follow-up and the like for all the buyers. These routines are specialized by function; the contacts with the market are specialized in terms of the products and commodities purchased.

It is interesting to note that the trend toward centralizing authority in one man for materials procurement, which so often accompanies growth of a business unit, may eventually reverse itself. It should be pointed out, however, that when decentralization develops in a large business, a quite different set of executives share the responsibility as compared with the group that divides the purchasing activities of the small business.

8. WHO SHOULD BUY

General characteristics and trends cannot be depended on to provide the answer as to who should do the buying in a specific situation. The conditions that govern the various situations which give evidence of trends are important considerations in getting an answer to a new problem. Definitely, however, the trends and general practices are not answers themselves, nor do they provide ready-made answers. Such matters as personal characteristics of the individuals concerned, past practices, and the nature of the finished product and method of processing it bear directly on the problem and at times are determinants.

9. THE EXPERIENCE OF THE KINGSLEY SHOE COMPANY

The Kingsley Shoe Company, a prominent manufacturer of women's and children's high-grade shoes, had been experiencing a period of slack demand. This condition was general throughout the industry. As a part of a cost reduction program a competent executive was placed in charge of the central storeroom and of the purchasing of manufacturing materials.

Purchasing of raw materials was an important function in the operating program of the Kingsley Shoe Company. In the period of abnormally high demand which had preceded the current recession, the chief task of the purchasing agent had been to secure a sufficient volume of raw materials of proper kind, delivered when needed. Cost of raw materials had been of secondary importance because prices of shoes constantly had been rising, and this made it possible for the manufacturer to pass any increased charge on to the consumer.

The recession reversed conditions. Prices of shoes stopped their upward swing and started downward slightly. Prices of raw materials also began to fall a little, but these changes were irregular and could not easily be forecast. Coincident with the lowering of price, there appeared to be a tendency on the part of many producers of raw materials to lower quality. Such a situation was particularly serious for the Kingsley Shoe Company, which had long jealously guarded the quality of its shoes. Furthermore, the sales department, in attempting to check declining sales, was insistent upon the adoption of a large number of style changes. By this means the sales manager hoped to stimulate a new buying interest on the part of his customers. As a result of frequent style changes many of the raw materials which would, under normal conditions, be bought in large quantities now had to be purchased on a hand-to-mouth basis. Otherwise, raw materials inventories would pile up.

Furthermore, the new styles resulted in a need for many new items such as new styles of heels, toes, tips, counters, bows, buckles, and many fancy leathers such as kid in many bright colors, snake skin, and alligator skin. The task of estimating the exact requirements for such items was very difficult in itself, and style shifts might leave the company with a considerable amount of money invested in materials which, if not entirely unusable, would at least be very slow moving.

Because of unsettled conditions in the shoe industry and the resultant policy of tighter control adopted by the Kingsley management, the executive in charge of purchasing adopted a policy of routine buying; *i.e.*, he bought only according to actual current needs, and so far as possible in stipulated amounts at regular intervals. The new purchasing executive did not have charge of buying upper leather, which, because of the large volume needed and the frequent style changes, required the entire time of a specialist. Since upper leather constituted the largest single item of cost in the production of a shoe, effective purchasing of it might easily represent the difference between profit and loss for the Kingsley Shoe Company. The new plan of centralized purchasing had been set up on the first of January In the following August the purchasing agent had to decide whether to continue buying linen thread on a routine basis or to contract for at least a year's supply.

10. THE PROBLEM OF LINEN THREAD

Under the new plan, purchasing and raw materials stores control were separated completely from the control of the manufacturing departments. The latter placed requisitions with the storeroom for materials and were charged therefor on the stores department records. Beginning in January the purchasing executive kept charts covering internal information of interest to him in purchasing—factory production, sales, orders from salesmen, and materials on order. He received also sales and production estimates made by the management. In the storeroom, balance-of-stores cards were used. On the basis of records of materials turnover, and through his knowledge of the delivery period on orders, the purchasing agent worked out a graduated system for ordering. When withdrawals, as shown on the balance-of-stores sheet, brought the quantity in stock to a point predetermined from the above information, this condition served as a warning to buy the necessary quantity. The new system, however, was not inflexible. The purchasing executive used his judgment as to purchases, even if the quantity on hand was below the specified limit, since by waiting he sometimes obtained a lower price.

By June, production in the factory was approximately 3,500 pairs of shoes daily, of which 50 per cent were welt-soled. The linen thread used in the manufacture of a pair of shoes was less than 1 per cent of the total cost. Thread required to sew uppers to welts was an eight-cord linen thread. This measured approximately 800 yards to the pound, and an average of 3 yards was required per pair of shoes. Linen thread was manufactured from flax raised in Ireland, Belgium, and Russia. The Russian crop, however, was not used in American production, and most of the flax imported for this eight-cord thread came from Belgium. In Belgium, flax harvested in the fall underwent processing which took approximately eight months before it was manufactured into thread. This Belgian method of preparation gave a fineness of quality such that American thread manufacturers contracted for a year or more ahead of requirements in order to ensure continuity of supply. In July, the purchasing agent learned from trade reports that the Belgian crop which had been used in current thread manufacture was practically exhausted and that the oncoming crop, then being marketed, was likely to be less satisfactory and might make a weak thread. The thread in current use was one of exceptional quality.

The purchasing executive had made exhaustive tests of linen thread for tensile strength, for frictional wear, and for yardage per pound, and he realized that quality was a preeminent factor. A break in thread on the shoe machinery in course of production involved ripping uppers from welts with the possible destruction of welts as well as uppers, and the extra time required for ripping and resewing. After the shoe was sold, poor wearing qualities were sure to reflect on the reputation of the Kingsley Shoe Company. As a matter of policy, all shoes were sold under brands, and the quality of brands was maintained rigidly in order that women who bought any brand might know exactly what to expect on a second purchase.

Production from the thread in current use might continue for another three months, after which thread from the new and supposedly inferior crop would be used. On a routine basis, each purchase was one case of 168 pounds; below this unit, no quantity discounts were allowed by thread manufacturers. During the period of greatest demand, the price of linen thread had been abnormally high and in June of the current year had been $2.85 per pound. In August, the price dropped to $2.70 per pound, and further decreases were not unlikely.

An analysis by the purchasing executive of each six-month period of the previous year and of the first half of the current year showed that the factory had used 1,000 pounds of eight-cord linen thread each six months. Estimates by the sales department indicated a comparable requirement for the ensuing year. However, production of women's shoes was highly uncertain because of increasing change in styles. Purchase of materials in advance of needs or contract for future delivery was contrary to the general policy of the purchasing executive and might leave on hand either material or contract for material which could not be used immediately. In either case a portion of the company's capital was tied up in slow-moving inventory. One of the chief tasks of the new purchasing agent was to avoid situations of this kind.

Although linen thread represented a small percentage of production costs and a marked change in its price was not likely to be reflected noticeably in the cost of producing shoes or in the selling price, the total sum involved, approximately $5,400 for a year's supply of 2,000 pounds, was substantial. Investment of capital in slow-moving assets was generally considered undesirable as tending to reduce company profits. However, there was no question of deterioration of material on hand, for linen thread could be stored indefinitely without loss of quality in properly humidified warehouses. So anxious were thread manufacturers to sell that if the purchasing executive bought or contracted for a year's supply of thread, he could secure a January 5, following, dating on bills covering deliveries during the remaining five months in the current year, although no additional discount for quantity could be secured.

On the other hand, continuation of routine purchasing released capital for active use, allowed the advantage of possible fluctuations downward in price, and reduced the risk of loss on possible changes in production. In addition, low inventories saved such charges as government taxes. It was not entirely certain that the quality of thread from the oncoming flax crop would be as unsatisfactory as was estimated.

The purchasing executive decided that in spite of his established policy of routine purchasing, the quality of thread was of such paramount consideration as to warrant purchase in advance of immediate needs. He placed his order for 12 cases of 168 pounds each of eight-cord linen thread to be made up from the flax crop in current use. One case was to be delivered each month at $2.70 per pound, and the buyer arranged for a January 5, following, dating on the invoices covering the first five months' deliveries.

11. EFFECT OF STYLE CHANGES

During the winter in which the new purchasing department was established, 50 per cent of the shoes marketed had welt soles. Welts were stitched to uppers, and the soles then were sewed to the welts by outside stitching. The purchasing agent estimated his need for thread on the 50 per cent basis when he signed the contract in August. During the following winter, demand became active for shoes with turned soles. Turned soles were stitched with the uppers inside out, and then the uppers were pulled over to their final shape. A lighter thread was used than for welt sewing. In the fall following the signing of the contract for a year's supply of thread, production was approximately only 30 per cent welt shoes, and the purchasing executive had in stock at the end of the period covered by his contract 1,000 pounds of linen thread. The market price, after a gradual decrease, reached $2.60 per pound.

12. THE SOLUTION OF THE THREAD PROBLEM

The procurement of an oversupply of eight-cord linen thread was the result of a judgment decision. The purchasing executive believed that the quality consideration was more important than the risks of loss from overbuying. His judgment in this respect probably was sound. Nonetheless, he was much disturbed by the outcome.

In analyzing this situation the purchasing officer concluded that the basic element in the problem was the variable quality of the flax crops from which the thread was made. Inquiry revealed that uncontrollable natural conditions were responsible for these variations from crop season to crop season. The purchasing officer concluded that the problems of when and how to buy linen thread would continue and that there was little he or his company could do about it. He believed firmly that quality was the most important consideration when purchasing this particular item.

About this time a rėpresentative of a company manufacturing thread from synthetic filaments called on the Kingsley Shoe Company. He was aware of the quality variability of linen thread and urged the purchasing executive to consider switching from linen to a synthetic filament thread. He demonstrated conclusively the fact that the synthetic thread was fully as strong as the best thread made from flax. He emphasized that because the synthetic thread was produced from a man-made fiber that its quality could be controlled and maintained without variation. His company was quite willing to guarantee the quality and quality stability of the threads it produced. Reliable tests for the various characteristics that made for quality in a thread were readily available. He urged that by proper testing the Kingsley Shoe Company would run no quality risks if it switched to synthetic filament thread.

The prices of threads made from such synthetics as rayon and nylon were stable. As competition in the production of these threads had increased, the prices charged for them had shown a steady downward trend. Currently the price for the synthetic filament thread recommended for use by the Kingsley Shoe Company was slightly higher than the current price of linen thread. The salesman stated that he believed this price would be reduced within a year. He pointed out also that the current low price of linen thread was likely to be advanced.

The Kingsley purchasing officer found by investigation that a number of manufacturers of high-quality men's shoes were using synthetic thread and found it particularly satisfactory where stoutness and abrasion resistance were essential to satisfactory wear. In talking with officers of these companies, the Kingsley executive learned that whenever one of these companies had changed from linen to synthetic thread a period of experimentation and adjustment was required in the stitching operations. This concerned such technical matters as tension on the machines, length of stitch, and rate of feed. No major changes in stitching equipment were necessary as it was possible to get satisfactory results from existing equipment when properly adjusted and when workers became experienced in the use of the different thread. The Kingsley purchasing officer found no case in which a shoe company that had changed to synthetic thread thereafter changed back to linen thread.

Because he realized the seriousness of the impact of the switch on the company's production operations the purchasing executive referred the problem to the operating management of the company. He recommended careful and thorough study of the proposal because he saw in it the possibility of relieving the company of a troublesome situation and at the same time enhancing the reliability of his company's product. Both the general manager and the sales manager were much interested in the proposal. The factory manager was somewhat less enthusiastic. However, he agreed that the new thread should receive careful investigation.

Over a period of several months various types and weights of the synthetic thread were tried out. Experiments in machine adjustment and stitching were carried out. While the experience was troublesome and occasionally irritating, the efforts finally were successful. These experiments were conducted using synthetic thread samples supplied by three different thread manufacturers as the purchasing executive did not wish to become dependent upon a single supplier for such a critical material. It was demonstrated that these threads were satisfactory for the company's use. Executives decided to make a gradual shift to synthetic thread.

13. SUMMARY AND CONCLUSIONS

Experience of the Kingsley Shoe Company. The experience of the purchasing executive of the Kingsley Shoe Company illustrates some of the difficulties involved in effective purchasing of raw materials. The task of purchasing the required items in such a manner and at such a price that they flow into the factory economically when, and only when, needed is far from simple. For instance, in determining when and how much linen thread he should buy, the purchasing agent of the Kingsley Shoe Company had made a genuine effort to analyze the problem before him. In the last analysis he had to choose between price and assurance of supply of the desired quality. There seemed to be no reasonable way in which he could protect his company against unfavorable fluctuations in both these factors. He finally decided that quality supply was paramount and purchased linen thread accordingly. He lost money by so doing and on the face of it appears to have gone contrary to the general spirit of the company's program. A discerning general manager would, however, look beneath the surface and would probably conclude that, although the purchasing agent had lost money, he had actually safeguarded the reputation of the firm as a quality producer and that the money lost in the purchase of linen thread should be considered in the nature of insurance for quality. On the other hand, the purchasing agent of the Kingsley Shoe Company could not make many "mistakes" of this kind without encountering serious objections from the general executives. His decision to investigate the possibilities of synthetic filament thread certainly was sound.

Natural versus Synthetic Raw Materials. The change to synthetic thread is illustrative of a definite trend in manufacturing. There is a tendency to prefer many man-made materials to the natural materials they replace. Natural materials are the product of nature's influences. In many cases the variability of these influences results in variability of the materials themselves. When standardized operating methods must accommodate themselves to fluctuations in the characteristics of the materials processed, difficulties often arise. Not infrequently these changes in raw materials have an effect on the quality of the finished output. Often, were it not for materials variability, less skilled, less costly labor could be employed. Frequently some writer in a technical journal is foreseeing the time when most raw materials will be produced synthetically to the exact specifications of the buyer-user. The replacement of a natural fiber thread by a synthetic filament thread is typical of this trend in raw materials supply.

Objectives in Raw Materials Control. The objectives of the business manager in controlling his raw materials supplies are clear and unmistakable. He wishes to have his company ensured a minimum, adequate supply of the proper quality of raw materials at the machine or workbench at the exact time they are needed for processing, at a price which (over a period of time) will ensure quantity, quality, and service at the lowest cost per unit of product.

Raw Materials as a Cost Factor. The necessity of accomplishing this result will be appreciated when one stops to consider the relative importance of raw materials as a factor in the cost of production. Today, out of each dollar received from sales, the purchasing department of the average manufacturing company spends 50 cents or more in buying goods and services, not including direct labor. Raw materials, then, often are the major item in cost of production. Their economical purchase and effective handling are, therefore, matters of first importance in practically every factory.

On the surface there is a vast difference between the purchasing problems in a steel mill which annually uses thousands of tons of ore and those of a manufacturer of watches who makes thousands of delicate hairsprings from a small block of fine steel. The tasks in the two purchasing departments in question vary in many important respects, but underneath the surface the need for the right quality, quantity, service of delivery, and cost is present in each case.

The Purchasing Function. Performance of the purchasing function involves several things: (1) a detailed knowledge of the company's raw materials requirements, (2) a knowledge of world sources of materials supply, (3) the adoption of an effective policy as regards the utilization of the sources of supply, (4) the choice between suppliers in carrying out the policy, and (5) the control of materials inventory after the materials have once reached the factory. The last of these activities will be dealt with in Chap. 20, Raw Materials Inventory Control.

Who Determines What to Buy? Effective determination of the quality and quantity of purchased materials and supplies requires the collaboration of engineering, production, and purchasing executives. Engineers contribute from their knowledge of functional requirements; production executives know the relative ease or difficulty and cost of operation when using one kind of material as an alternative choice to another; purchasing executives know what is available in the market both as to quality and quantity. They also are informed on prices and often are able to suggest alternative materials with favorable quality or cost characteristics. The purchasing department can also be looked to for information as to delivery and other forms of service.

Once standards of quality are determined, the purchasing department must adhere to these standards until they are changed as a result of another cooperative decision.

Scope of the Purchasing Executive's Activity. When purchasing activities are functionalized and responsibility for them is placed upon the shoulders of one major executive, we normally think of him as buying the raw materials, parts, and supplies needed to keep the plant in operation. There has been recent evidence of a tendency to expand the scope of the purchasing officer's activity beyond these common bounds.

The purchasing department may buy such equipment as typewriters, adding and calculating machines to be used in company offices, and drinking-water coolers to be used throughout the plant. When a company decides to install an intraplant communication system, should the purchasing department decide whether the system will consist of telephones or telautographs, what types of these to buy, and where to buy them? Should the purchasing department buy the small tools and devices needed in the shops? If the answer to this is yes, should the purchasing department select the specific tools and devices and decide from whom they shall be purchased and the price to be paid? Should the purchasing department go further and upon requisition of the operating departments select and buy the machines, large and small, with which the plant is equipped?

Occasionally a purchasing department buys all these things, and there are rare cases where the responsibility of the department has been extended to the procuring of the company's advertising. Some purchasing departments buy part of the items here listed but do not buy others. Most departments buy few or none of them. In practically every case the answer depends largely on considerations similar to those which influenced the Kingsley Shoe Company to omit upper leathers from the list of materials for which the purchasing executive was responsible.

The answer for any specific item is not obvious and in many instances is not easy. Usually there is little objection to the purchasing department's selecting and buying drinking-water coolers. In the case of office typewriters, there may be more objection. However, the purchasing department should have no difficulty in ascertaining and giving due consideration to preferences of the office organization as to writing machines, and the arguments for having such equipment bought by the purchasing department are frequently very strong.

Successful purchasing of tools and heavy plant equipment by a general purchasing department is much more difficult. Of necessity this involves cooperation of several groups of interested individuals. In most instances selection of such equipment and source of purchase will be dictated by engineering and production executives, and rightly so. In that event the task of the purchasing department becomes routine and clerical in nature, and the opportunities for the purchasing department to make much contribution are not great.

Importance of Knowledge of Sources of Supply. Knowledge of world sources of supply is very important in the case of many materials. This was true of linen thread in the Kingsley Shoe Company case. The United States and many other countries produce flax. Investigation will show, however, that most flax grown in the United States has too short a fiber to make linen thread suitable for sewing shoes. Even in those parts of the country where long-stemmed flax is grown, the amount annually marketed is uncertain, and retting and processing have not been well developed. It would be unwise for a purchasing agent to depend on such sources for flax. Russia produces good flax, but political conditions there have been such as to make that source not acceptable. Belgium, on the other hand, has been producing flax for many generations. Reliable stock has been developed. Exactly the right kind of seed is planted in the right soil to give the desired stalk. The retting process, while perhaps appearing antiquated according to American industrial methods, produces a fiber that makes first-class thread. Information of this kind is a necessary part of the equipment of any executive who is required to purchase linen thread. Exhaustive knowledge is necessary for every purchasing agent. He must know sources of supply, both domestic and foreign.

Choice of Suppliers. It is usually desirable that alternative sources of supply be available. Sometimes many sources should be developed and maintained; in other cases two or three sources will be adequate. There are situations in which it seems advisable to confine all purchases of one commodity or part to a single source of supply. In general, the question of number of sources comes down to the effect on risks of price, quality, regular and emergency delivery, and other "service," such as information on forthcoming price changes, promptness in adjustment of errors, and accuracy and rapidity of billing. Reduction of these risks, individually and collectively, should be the objective in deciding from how many sources to buy.

The question of which sources to utilize involves consideration of the same factors. Decision here usually requires careful weighing of the advantages and disadvantages of one source against the advantages and disadvantages of one or several others. It is usually a case of relative merit. The answer, then, involves (1) careful determination of just what characteristics are most important, and (2) judgment of the relative desirability of various suppliers measured in terms of the required characteristics. The trend seems definitely toward the creation and maintenance over a period of time of desirable relations with a few reliable suppliers. This may mean some sacrifice in immediate price. But here again we must remember that trends are not answers, and that the answers implied in general practices and trends may be dangerous.

Types of Purchasing Policies. The policies which purchasing executives use in utilizing sources of supply are many and varied. Sometimes an executive adheres to one policy; other executives follow more than one. Just what the individual agent should do will depend, of course, on the circumstances facing him. Some of the more typical purchasing policies will be discussed.

Materials Purchase versus Materials Production. One of the first questions that presents itself to company executives is: Can this company develop its own source of supply to greater advantage than it can purchase from others? Some years ago the steady rise in the price of crude rubber convinced certain American tire producers that they should not be dependent on foreign sources for raw materials. Rubber had not yet been grown in this country on a suitable commercial basis; millions of dollars have been spent in attempting to develop overseas sources under the immediate ownership and control of individual American companies.' It would appear that a clearer, more intensive analysis of the world rubber situation might have indicated what experience has since proved, namely, that the high prices then existing were the result of temporary conditions.

Again, a large manufacturer of cotton goods decided to use rayon as a complementary material. The idea proved sound, and soon the question arose as to whether or not this company should erect its own rayon plant. After a critical investigation, company executives decided that because of the large initial investments required, the difficulties in processing rayon, the difficulty of securing proper supervisors to run a rayon unit, and the great likelihood of revolutionary changes in rayon making, the erection of a rayon plant would be unwise. Accordingly, this company has continued to purchase its rayon yarns from rayon producers.

The factors which must be considered in deciding whether to produce or purchase raw materials are so many and varied and differ so widely as between companies that individual decisions always must be reached on the basis of specific circumstances surrounding a given manufacturer. Much of the discussion in Chap. 8 in regard to vertical integration is pertinent in this connection.

Long-time or Short-time Contracts. Many purchasing agents insist upon written contracts when buying raw materials. Such documents, if properly drawn, are legal and enforcible in courts of law. When purchases are being made on contract, the length of time covered by the contract is always important. For several years the purchasing executive of a food processing company had contracted for an annual supply of cans according to need as each year's canning season approached. The plan had the advantages of permitting the company to profit by any favorable price changes and any new sources of low-cost supply that might develop. It had the disadvantages of not securing such efficient service from the can manufacturers as could be secured if a long-time contract was entered into. The need of quick service from the manufacturer was an important item, for the cannery found it difficult to estimate its requirements exactly. The solution of the difficulty was the signing of a three-year contract with prices to be adjusted on the basis of market price of tin plate at the beginning of each year. The cannery was thus ensured service and protected in part from undue price advances. The price tended to be relatively low, for the manufacturer's cost of selling the account was less because of the three-year contract. Long-time contracts are also at times of advantage to materials suppliers in that they help to assure volume of output. Factors such as these influence suppliers to grant favorable consideration to buyers who are able and willing to enter into long-time purchase contracts.

Purchase on Specification. Some buyers prefer to purchase on specification; *i.e.*, they draw up a long list of details covering every known phase of the purchase transaction. These specifications, when signed by both parties, are enforcible in courts of law. Purchasing by specification has many advantages in securing for the purchasing agent exactly what he wants in the way he wants it. The great weakness of such a plan is that it is very difficult to include in written specifications all the factors that are normally understood as a part of a purchase transaction. Often unforeseen changes make modification of the original plan advisable. The omission of any details or the violation of any specification, however trivial, may invalidate the whole transaction.

The setting forth of materials specifications in writing has the obvious advantage of fostering clarity and understanding. However, complete dependence on such written instruments has decided shortcomings as compared with their use as a means of supplementing established mutually advantageous relations between buyer and seller.

Maintenance of Two or More Sources. To maintain adequate sources of supply many purchasing executives follow the policy of always purchasing from two or more sellers of a given material. Some executives believe it is unwise for their companies to depend on only one source since an untoward situation might arise which would render that source unusable. Neither is it considered good policy from a price standpoint to be at the mercy of one supplier. Competition, so the argument goes, leads to better prices.

The decision to use one or more than one source of supply is not always simple. It depends on a consideration of such factors as price trends, the possibility of buying in the "spot" market, the location of the suppliers in question, and their reliability as to quality, promptness of delivery, and capital and credit ratings, as well as upon past experience with the suppliers. Many of these same factors must also influence actual choice of suppliers.

Speculative Purchasing. The market for certain raw materials is highly dynamic. This is especially true of such commodities as cotton, wheat, wool, corn, and leather. Not infrequently, in fact altogether too frequently, purchasing agents for companies using large quantities of such products make their purchases upon a speculative basis. If they believe that the market is going to rise, they purchase or contract to buy two or three times as much raw material as they actually need. Then during the year as prices strengthen they sell the surplus to less far-sighted competitors.

Speculative purchasing has two outstanding weaknesses. To the extent that profits are made from this source, there is a seemingly irresistible temptation on the part of management to ignore the problems of production, substituting for profits from careful management the gains which result from speculative purchasing. Speculation at best is a highly uncertain venture. The purchasing executive cannot always guess or judge correctly, and when he misjudges, his mistake may be so serious that it brings heavy losses, if not eventual ruin, to his company.

A large textile plant, which followed the plan of speculative purchasing, reorganized its productive processes and during a 12-month period effected economies which resulted in savings of a half million dollars, only to find that during this same period its purchasing department had misjudged the market and had incurred a raw materials inventory loss of a million dollars.

A certain shoe company had a purchasing agent who specialized in the purchase of sole leather. He became convinced that the market price was going to go up. Since none of the purchasing executives in competing firms was preparing for such a change, he thought he saw a chance to make money for his company. He purchased a million dollars' worth of sole leather, expecting to sell portions of the supply to competitors when prices rose. Instead of increasing, the market weakened month after month, and the shoe company was soon facing severe financial embarrassment due to excessive investment in raw materials.

Speculative purchasing of raw materials (purchase in excess of production requirements) by the average factory buyer probably has little or no justification. The chief function of a manufacturing plant is to produce goods, not to gamble in the raw materials market. Unfortunately, the practice of speculative purchasing at times has been widespread. Some purchasing agents must deal in highly speculative markets. In such cases the device of "hedging" may often be used to safeguard legitimate purchases that must be made. In any event, a company which speculates in raw materials should so organize its books of account and its statements that they show profits or losses resulting from trading in raw materials separate from the profits or losses incurred as a result of manufacturing activities.

Use of Specialists. Many companies, especially the larger ones, find it advisable to specialize certain purchasing functions. Shoe factories frequently have men who do nothing but buy upper and sole leathers, or sometimes only one of these. A factory which uses hundreds of tons of coal annually may have an agent who buys nothing but coal. A large manufacturer of absorbent cotton and gauze products has found it advisable to specialize the purchase of raw cotton. To just what extent specialization will enter into the purchasing function depends on the circumstances surrounding the individual company. The nature of the materials purchased, the character of the markets in which they must be bought, the dollar volume of material required, the relative importance of the raw materials element in total cost to manufacture—matters such as these are the determinants.

Enough has been said to make it obvious that the control of raw materials is a major managerial task in the average factory. As stated at the beginning of this summary, proper control of raw materials involves five things: thorough knowledge of the company's materials needs, knowledge of sources of supply, adoption of a well-defined purchasing policy, choice between suppliers in carrying out the policy, and some means of inventory control of raw materials once they are in the factory. Inventory control will be dealt with in Chap. 20.

QUESTIONS

1. What is the meaning of the phrase "factors of production"?
2. How is management related to this concept?
3. What is the relationship between the function of the business manager as developed in this chapter and the nature of management as described in Chap. 2?
4. What is the "scope of the purchasing function" in relation to the "scope of the purchasing executive's activity"?
5. How does carrying out the purchasing function differ in the larger business from the way the function is performed in a small business? Is it because the functions differ? If not, why does it differ?
6. Compare decentralization of purchasing in the small business with decentralization of procurement in the larger business. In which, if either, is the situation "under control"?
7. What is meant by functional organization within a purchasing department?

8. When is the use of "buying specialists" for one or more materials sound?

9. The decision of the Kingsley Shoe Company purchasing officer to buy a year's supply of linen thread basically was the result of a "value judgment." Please be prepared to explain the meaning and significance of this statement.

10. What is your appraisal of the way in which the purchasing executive handled the synthetic fiber thread proposal?

11. Why have synthetic raw materials increased in popularity?

12. Is there a relationship between the increase in industrial specialization and the increasing importance of purchases as a factor in the cost of manufacturing consumer products? Explain.

13. When a company has an experienced, well-managed purchasing department, who should purchase the following items?

a. Paper napkins for the company restaurant
b. Crude rubber used in large quantities
c. Electronic testing equipment for use on a television assembly line
d. Paper towels for rest rooms
e. Motor trucks for local delivery purposes
f. Electric lift trucks for use in the company warehouse
g. Paint to be used for redecorating offices
h. A motorized fire truck for plant use
i. Handcuffs for the company police force
j. Personal injury liability insurance
k. Copper for the manufacture of tubing to go into all the company's several lines of refrigerator units and air-conditioning units and installations
l. Special alloy stainless-steel rod for making oil-burner gun points; required 1,000 pounds per year
m. Typewriter ribbons
n. Credit insurance
o. A special-purpose packaging machine costing $10,000
p. Hand fire extinguishers for use throughout the plant
q. An automatic data-processing installation involving expected royalty payments of about $100,000 annually
r. One hundred electric office calculating machines
s. Desk pen sets for the company's five chief executives

14. Would you expect that knowledge of world sources of supply as a requirement of effective purchasing will be affected by any increase in the number of nations linked in the European Common Market? Please explain.

15. How many sources of supply need a company have for one purchased item: one, two, more than two? What considerations are important in reaching a decision to this problem?

16. Be prepared to discuss the several purchasing policies discussed in this chapter.

17. Who would seem better fitted for the position of chief purchasing executive: an assistant sales manager who has been in the employ of the company for several years or a graduate of an engineering school who has been an assistant to the head of the company's product designing department for the same length of time? Explain.

PROBLEM 20 MONTENEGRO MOTORS COMPANY

The Montenegro Motors Company manufactured single-cylinder gasoline engines of 1 to 4 horsepower. It sold these motors to producers of such power tools as lawn mowers, snow blowers, garden tillers, chain saws, drainage pumps, and portable electric generators. The company purchased many machined parts, and currently management was considering revising its purchase specifications policy.

The company purchased crankshafts for its motors machined to specifications which permitted variation of no more than 1/1,000 of an inch in one critical dimension. On an order for 500 crankshafts that had been placed with a local machine shop, the company received shipment of 410 shafts on the stipulated delivery date. These shafts were to be assembled into a motor for which the company had an order for 490 units from one of its best customers, the Wilmington and Shaw Pump Company. Delivery of this order had been promised on a date which made for a tight assembly schedule for the 490 motors. All parts needed for the assembly except the crankshafts were on hand, and assembly was scheduled to start on the second working day after the day on which the 410 crankshafts were received. Assembly of 490 motors was expected to require three eight-hour workdays.

When the receiving department discovered that the shaft order was short by 90 units it immediately notified the scheduling department and the purchasing office. The buyer who had placed the order with the supplying machine shop immediately telephoned the machine shop.

He learned that the 90 back-ordered shafts were the result of improper adjustment of an automatic lathe used on a night shift for making the last finishing cut on the shafts. This was a difficult cut, and the machine shop always had an unusual amount of scrap on this operation, the specifications for which were 2.005 ± 0.0005 inches. This was a "tight" specification, meaning that no shaft with a diameter greater than 2.0055 or less than 2.0045 inches would pass inspection and be delivered to Montenegro Motors. A temporary substitute foreman on the night shift had failed to check the job adequately, with the result that only 410 of the 500 shafts machined were within the 2.0055 to 2.0045 limits. On 10 of the out-of-specification shafts the cut was oversize. These had been remachined on a nonautomatic lathe and would reach Montenegro Motors within a few hours by special truck. The balance of the shortage, 80 shafts, would have to be started over from raw castings which were to be delivered to the supplier in three days. "Was there any possibility that Montenegro could use the undersize shafts?" If this was possible, "they would be dispatched by special truck immediately and would reach Montenegro Motors within two hours."

The Montenegro buyer knew that the company's engineers made a practice of setting many dimensional specifications to tighter limits than was actually required for proper assembly and subsequent performance of the product. He told the supplier he did not know whether the undersized shafts could be used or not but that he would investigate because Montenegro needed the parts badly.

The buyer went immediately to the engineering department and explained the situation. He was told that actually any shaft not more than 1/1,000 of an inch over or undersize was perfectly satisfactory. The only reason that tighter limits were specified on this dimension was to make sure that the shafts would be within the looser tolerance actually needed.

The buyer telephoned the shaft supplier and asked how much the shafts were undersize and learned that none of them was too small by more than ½ of 1/1,000 of an inch. He said that if Montenegro could use these shafts that they would be billed at a discount of 20 per cent. The buyer informed the supplier that the limits actually necessary on this dimension were plus 1/1,000 inch and minus 1/1,000 inch and that he should send on the undersize shafts at once.

The supplier's representative said that the shafts would be dispatched within an hour. He then volunteered the information that if in the future the company would liberalize the tolerance on this critical dimension of its shafts to two-thousandths of an inch that the resultant reduction in scrap on this operation would make it possible to reduce the quoted price for the job 5 per cent.

The Montenegro buyer reported this experience to the company's chief purchasing officer. Shortly thereafter this purchasing executive raised with the engineering department the question of the wisdom of the company's policy of specifying tighter dimensional limits than the company actually required.

Should the management of Montenegro Motors change its specifications policy?

PROBLEM 21 DICKLAND COMPANY

Twice during the current year the Dickland Company, a manufacturer of filing equipment located in Columbus, Ohio, received advance information of price increases in cotton cloth from the Bown Company, which supplied it with 50 per cent of the cotton cloth used in the manufacture of tabs for index cards. The purchasing agent of the Dickland Company considered whether this service on the part of the Bown Company was sufficient to warrant giving that company 100 per cent of his orders.

The cloth used by the Dickland Company was the product of a manufacturer who distributed through wholesalers located in the principal cities of the United States. The prices quoted by these wholesale distributors were identical in the same territory. The company's annual requirements of cotton cloth were about 25,000 yards. It maintained an average stock of 2,000 yards. A new supply was ordered each month about four weeks in advance of actual use. For 15 years the Dickland Company had bought its total requirements of cotton cloth from the Rodas Company, a wholesale distributor also located in Columbus, Ohio.

During the last three years, a salesman of the Bown Company, a wholesale distributor of cloth located in Chicago, had called upon the purchasing agent of the Dickland Company in an effort to obtain orders to supply that company with its requirements of cloth. He had not obtained the orders because he had been unable to offer higher quality or lower price than competitors. During a visit to the Dickland Company's plant in the preceding June, he noticed an idle machine which had been installed to manufacture an article which the Dickland Company had found unprofitable to market. He offered to find a purchaser for this machine at the price asked by the company if the purchasing agent would give him a part of the orders for cotton cloth. As the machine had been idle two years, the company was anxious to dispose of it. The purchasing agent, therefore, told the salesman that 50 per cent of the company's requirements would be ordered from him if he sold the machine and if the service given by the Bown Company was as satisfactory as that of its competitors. Three weeks later the machine was sold, and the Dickland Company gave 50 per cent of its orders for the remainder of the year to the Bown Company.

During the remainder of the year, the manufacturer's price of the cloth that the company used was increased twice. This increase affected equally the quotations of the two distributors then supplying the company. On both occasions the salesman of the Bown Company notified the purchasing agent of the Dickland Company about a week in advance that an increase in price was expected and stated that the Bown Company was prepared to fill any requirements of the Dickland Company at the old price if the order was placed before official notice of the increase was sent out. The Dickland Company took advantage of this advance information, and in each case the price increased. The Rodas Company, however, did not notify the purchasing agent of the Dickland Company until several days after the advance in price took effect. The purchasing agent of the Dickland Company was uncertain whether or not this effort to give extraordinary service was sufficient to warrant giving the Bown Company 100 per cent of his orders.

Service of the Rodas Company always had been satisfactory to the Dickland Company. Deliveries were made punctually, and the company could expect to receive shipment within a maximum period of 10 days after placing the order. The Dickland Company maintained a stock more than sufficient to last over such a period. The Rodas Company had filled all orders in a businesslike manner, especially in regard to correspondence, prompt invoicing, and adjustments. Its location in Columbus, Ohio, was an advantage because the purchasing agent of the Dickland Company could communicate with the salesman or executives personally in a short time. Since the purchasing agent had bought all his requirements for several years from the Rodas Company, a relationship was established which made it probable that the Rodas Company would continue to give as good service as it had in the past. There was a possibility, moreover, that with advancing prices and increasing difficulty of obtaining materials it would be advantageous to have two sources of supply for the cloth. The purchasing agent could use the information furnished by the Bown Company to advantage in purchasing from the Rodas Company.

Service of the Bown Company in the matter of delivery and of carrying out the routine of each transaction was equal to that of the Rodas Company. The special service given by the Bown Company might not be continued after it was assured of the continuance of orders from the Dickland Company. The purchasing agent, however, believed that purchases should be made from the company which gave the better service on the basis of equal price and quality. Therefore, the proportion of orders placed with the Bown Company was increased gradually until it reached 70 per cent.

Should the purchasing agent buy all the Dickland Company's cotton cloth from the Bown Company?

PROBLEM 22 BALLINGER FURNITURE COMPANY

The main offices and sales organization of the Ballinger Furniture Company were located in Chicago. The company manufactured standard-type wooden chairs, reed and fiber furniture, and several special types of furniture. Nine factories and ten assembly warehouses were operated. All sales were made directly to retailers with the exception of opera seats and school furniture. These were sold through agents. The Chicago executives were considering the establishment of a central office to purchase the raw materials and supplies required by the factories and warehouses.

The Ballinger Furniture Company was created by Mr. Tonas Ballinger during the period between the Second World War and the Korean conflict. With the death of his father he became owner-manager of the Acme Chair Company, an old, well-known producer of medium-priced dining-room chairs. With the financial backing of a Chicago bank he acquired the properties of two smaller competitors and six other manufacturers of specialized furniture and related items such as baby carts and carriages and coco-fiber mats. In 1961 the sales of the resulting organization, the Ballinger Furniture Company, had grown to exceed $90,000,000.

The general management of the company was located at the corporation headquarters in Chicago. Mr. Ballinger was president and general manager. He was assisted by a sales manager, responsible for all sales of the company, a merchandise manager responsible for product design, a treasurer, a comptroller, and a "warehouse manager."

Production management was decentralized. Each factory manager and each local warehouse manager was responsible for the complete operation of his plant. He had no responsibility for product design, sales, credits, or collections. Local managers were not responsible for purchases of lumber or imported reed or fiber. All other purchases were made by local purchasing agents at the factories and warehouses. Three lumber buyers reported directly to Mr. Ballinger. A company representative in Singapore bought reed, and an agent in Bombay supplied the company with fiber. These overseas buyers reported directly to Mr. Ballinger.

Four of the company's factories were located in the Middle West, three were in different communities in the South, one was on the Pacific Coast, and one was in Canada. The 10 warehouses were located in strategic marketing centers throughout the United States. The accompanying table shows volume of production and products manufactured at each of the 9 plants and the 10 warehouses as a group.

Factory	Annual production costs, dollars	Products							
		Wood chairs	*Baby carriages*	*Reed furniture*	*Fiber furniture*	*Coco mats*	*Aluminum furniture*	*Opera seats*	*School furniture*
Weston.....	7,200,000	x							
Newberg...	6,500,000		x	x					
Dalton.....	2,100,000		x		x	x			
Dancliffe...	4,500,000	x					x		
Ontario .	8,100,000	x	x	x					
Hanselville	4,000,000	x						x	
Big Run. ..	2,200,000								x
Nycroft ...	1,850,000		x	x					
Warehouses	11,000,000	x							

All warehouses were assembly and finishing establishments. Chair parts made at the factories were shipped to the warehouses. There they were assembled and finished. Shipments of chairs to retailers were made from factories or from warehouses as the particular circumstances of an order indicated to be most desirable. Most shipments of baby carts and carriages were made from the factories direct to retailers. Three of the warehouses carried small stocks of these items to serve as fill-ins when a local retailer reordered and needed quick delivery. All other company products were shipped from the factories. All billings covering shipments from factories and warehouses were made from Chicago.

Originally each of the eight manufacturing companies acquired by Mr. Ballinger had done its own purchasing. As the company grew, purchases of all furniture lumber were centralized in Chicago where three experienced lumber buyers contracted with various suppliers for the entire needs of the corporation. Local factory managers ordered lumber direct from these contract sources. Copies of their requisitions were sent to Chicago headquarters. Contracts for imported reed and fiber for reed and fiber furniture were made by Chicago. Supplies of these materials were shipped from overseas exporters to the using factories. At the factories and warehouses 38 purchasing officers bought all other materials and supplies needed locally. This buying commonly was on a current need basis. These buyers were responsible to their local managers.

All purchases of equipment were made by the plants and warehouses. All capital purchases in excess of $500 per item had to be referred to the general manager at Chicago. Once central office approval was obtained, local management was responsible for actual purchase.

During 1961 a comprehensive study of operating costs was made. For the corporation as a whole, manufacturing costs were as follows:

Raw materials	53%
Labor	28
Burden and Overhead	19
Total	100%

It was found that costs for comparable items varied greatly from factory to factory. Labor costs differed as a result of local conditions, methods of wage payment, and the like. The widest variations were in materials and supplies purchased. For example, costs of lacquers and varnishes at one warehouse were twice the costs of comparable items at one of the factories.

Study of the results of this survey resulted in a proposal to centralize all buying in Chicago. Local procurement would be limited to those items on which the annual expenditure did not exceed $50. An experienced procurement executive would be employed in Chicago. He would have a staff of assistants who would handle all buying and all paper work required to satisfy the needs of the factories and warehouses. A testing laboratory would be established.

For items used by more than one installation or purchased repeatedly by any installation, a catalogue would be prepared. It would contain descriptions and specifications of approved materials and would list approved supply sources for every item. Local managers would fill their needs by selecting from this catalogue and would forward purchase requests to Chicago. The Chicago office would place orders and follow up on deliveries. Required items not included in the catalogue would be purchased by the central buying office on requisition from a local operation. Purchase of both light and heavy equipment such as typewriters, motor trucks, power and hand tools would be handled in this way. The company used substantial amounts of decorative fabrics for theater chairs, cushion covers, baby carriages, and the like. In the past, local managements had purchased these fabrics from samples submitted by fabric finishing houses. Under centralized procurement this practice would be changed. Chicago buyers would buy gray (unfinished) cloth and would have it printed, dyed, bleached, and finished to designs developed by the company's own merchandise department.

Local managements would be responsible for determining and maintaining proper inventories. Costs of all purchases made for the factories and warehouses would be charged to these managements at cost plus a loading charge to cover the expense of operating the central purchasing function.

It was believed that centralized purchasing for all company units would result in lower costs as well as elimination of variation in cost of materials when purchased locally.

In discussing the type of man he wanted in charge of this operation, Mr. Ballinger said the most important requirement was that the man "be a good manager who could establish and maintain good working relationships with local managers." The personnel of the new department would have to include people who knew sources of supply thoroughly, people with technical ability to set up buying specifications that would assure each factory and warehouse of the materials they should have, and buyers who would be "shrewd shoppers."

Be prepared to discuss the gains that might be expected from the proposed centralized purchasing, the risks involved, and the problems that would be encountered and would have to be solved.

PROBLEM 23 SOUTHERN BAKERS, INC.

Southern Bakers, Inc., a baking company in a Southern city, was faced with the necessity of supplying new personnel for its purchasing department. Resignation of the purchasing agent and his assistant had left no one familiar with the problems and routine of the department, nor was there anyone in the employ of the company experienced in purchasing the materials and supplies required for daily operation of the company. It would take some time to find a man with the requisite ability and experience to head the department, and, since it was essential to make provision at once for supplying the constant day-to-day requirements of the company, a young man was transferred from the accounting department and temporarily put in charge of purchasing activities.

Southern Bakers, Inc., was an old and well-established company which had been built up as a family business and was not connected with any large baking combine. It had established a reputation for high quality of a wide variety of bakery products, and its sales amounted to over $2,000,000 yearly. The major portion of sales was made from house to house.

The purchasing department was responsible for buying all the materials and supplies used by the company. These were of several types and consisted of hundreds of items. The principal baking materials were wheat flour, other wheat products, special flours and meals, sugar, salt, shortening, butter, eggs, milk, and various fruits and flavorings. Wrapping materials of many kinds, office supplies, general plant supplies, and repair materials also were purchased. Practically all the principal purchases were made on the basis of contracts with local brokers and manufacturers. These contracts stipulated that the volume covered must be taken by a certain date, that deliveries would be made at times requested up to that date, and that each delivery would be billed on the date of shipment. The terms were usually f.o.b. Southern Bakers, Inc., plants or nearby railroad terminals or piers. Commercial truckmen were hired to bring goods from piers and railroad terminals.

After the resignation of the purchasing agent, company executives discovered a serious inventory situation which required immediate attention. The warehouse was full of flour, and large quantities were still in freight cars and lying on piers, accumulating heavy demurrage charges and in danger of damage. Furthermore, some of the contract time limits apparently were overdue since mills were demanding that flour be taken. Storage facilities of the company were already overtaxed, and it seemed undesirable to have more flour shipments coming in.

The president of Southern Bakers, Inc., decided to place a young man, Albert Clinton, from the accounting department, in temporary charge of the company's purchasing. Effort immediately would be made to find an experienced purchasing executive, but until such a person was employed Clinton was to endeavor to keep the material needs of the company supplied and to settle such other problems of the purchasing department as required immediate attention.

Mr. Clinton was a young man with some business experience. He had spent one year at a graduate school of business administration and had been employed by Southern Bakers, Inc., for the summer. In the fall he was going to return to school to complete his business training. Mr. Clinton was not experienced in purchasing, nor had his few weeks in the company's accounting department enabled him to become very familiar with the material needs of the concern. However, he expressed willingness to accept the job and was at once transferred to the purchasing department.

In addition to the growing surplus of certain raw materials, other immediate difficulties faced Mr. Clinton. In some instances he was unable to locate copies of important contracts in the files. In the past, shipping instructions had been given over the telephone, and he could not locate complete notations of the facts. Freight shipments were arriving in quantities larger than were called for by such notations as were available, and Mr. Clinton believed that some dealers were making larger shipments than had been ordered. However, he had no means of substantiating that belief.

Information as to the condition of inventory of materials was meager. Each day the chief receiving clerk would look at his stocks to estimate the quantity on hand and amounts of each item needed. With so many varied items, such visible control was difficult, and it was inevitable that he would make occasional mistakes necessitating special trips into the city for small orders; on the other hand, too much of one article was sometimes ordered. The production department sent weekly reports of the consumption of the major materials to the accounting department for cost records. Mr. Clinton had to apply to the accounting department if he wished these figures.

There had been no detailed system of inventory control. The receiving clerk, of course, remembered many pertinent facts from past lem. Industrial executives are both fortunate and unfortunate in that the question of plant location is of infrequent occurrence.

3. WHY FACTORIES ARE LOCATED WHERE THEY ARE

The location of a particular factory may be the result of sheer accident or the culmination of many months of study on the part of highly paid specialists. Usually the decision is the outcome of a solution proceeding that lies somewhere between these two extremes. A plant may be located in a town simply because it is the home of a promoting management. Plants so located are not necessarily poorly located. The promotion and location often are the result of recognition of local need.

Nor does the expending of much time and money in the making of highly technical location surveys always ensure excellence in location. An actual case in point is a blast furnace which, because of poor location, has been in operation less than half the time since it was built. Currently it is shut down, for how long no one is sure. Several months and much money were spent in investigation of the suitability of the location finally recommended in a lengthy technical report. The recommendation was accepted, and millions were spent in the erection of a plant. The location soon proved far less satisfactory than was expected. The reason was a change in transportation methods and rates for pig iron from Southern furnaces into the market the new plan had expected to serve. Other examples of similar nature have forced the conclusion that careful investigation, while important in selecting good plant location, is not absolute assurance of permanently satisfactory results.

Study of engineers' reports on plant location quickly reveals a general pattern. They commonly consider the nature of the product and its processing in relation to such matters as nearness to market, accessibility of raw materials, labor supply, power supply and cost, fuel and water requirements, climatic conditions, and availability of capital. In addition to such common factors, almost any specific case presents certain peculiar conditions. Examples that can be cited are local tax concessions, availability of specialized scientists and technicians for consultation, advertising values of a location, or need of providing specialized engineering services to the market. It may be trite to say that each location problem should be looked upon as peculiar in itself. Nevertheless, it is important to emphasize that fact. There is no general formula. There are common factors which are important. Correct solution more often than not is to be determined by characteristics of a specific situation which are less common than the old standby, distance to the market.

4. THE EXPERIENCE OF THE AUTO-STOKER COMPANY

The Auto-Stoker Company paid $200,000 for an industrial property in Cleveland, Ohio, consisting of three buildings containing 65,000 square feet of floor space located on a three-acre tract of land. At that time the company's output was being manufactured in a small, modern plant in Portland, Oregon. The product was shipped by rail to Pacific Coast points, by water to the Atlantic Coast, and by rail or rail and water to interior points.

5. NATURE OF THE PRODUCT

The Auto-Stoker was a device for forced underfiring of furnaces. It was described in the advertising circulars of the company as follows:

> The Auto-Stoker is so simple that anyone can easily understand it. You simply fill the hopper with cheap coal; beneath the hopper is a screw shaft like that in your food chopper, but much larger. This carries the coal into the furnace, feeding the fire from below; the same quiet little motor which feeds the coal to the fire also operates the ball-bearing fan which supplies air in just the right proportions to produce the greatest heat.
>
> The Auto-Stoker principle of forced underfiring does away with ashes. The intense heat which the Auto-Stoker produces (500 to 1,000 degrees hotter than hand firing) melts the ashes and fuses them into solid pieces easily lifted out with tongs at the same time you fill the hopper—about once a day.
>
> In forced underfiring a constant supply of slack, screenings, or buckwheat coal is fed to the fire from below. The exact amount of air necessary for complete combustion is forced into the fire. The whole machine starts and stops automatically to keep the exact steam pressure desired, regardless of variations of load or outdoor temperature.

The burner wherever installed had resulted in a saving of 15 to 50 per cent of fuel costs, and the company had received ample testimonials from customers to prove this saving.

6. HISTORY OF THE COMPANY

Prior to the formation of the Auto-Stoker Company in 1923, the burner had remained an obscure product for lack of adequate capital to push the device on the market. In 1923, a new company, adequately capitalized, introduced the product in the Eastern markets and after three years' pioneering work began to experience a rapid growth.

National advertising was started in the fall of 1923 in greenhouse magazines, and a similar and slightly larger campaign was conducted in the fall of 1924. In 1925 advertising was started in the *Saturday Evening Post,* and use of this medium has continued with increased space each year. From time to time other national publications were added to the advertising schedule: *Business Week, Time, Better Homes and Gardens, House and Garden,* and *House Beautiful.*

A business of $630,000 was done in 1926, and in 1927 the amount doubled. Distribution in 1928 was through approximately 300 dealers chiefly in the Middle West, New England, and the Middle Atlantic states, with one branch office in St. Louis and another in Cleveland. There were 15 missionary salesmen, operating out of the branch offices and Portland, whose business it was to assist the dealers in pushing the product. As an additional aid, the sales manager made an annual tour with other executives of the company to hold sectional sales conventions attended by dealers. By 1928, less than 4 per cent of the burners were sold in Oregon and over 75 per cent of the company's market was east of the Rocky Mountains. The company was well on its way to becoming of national importance in the stoker industry.

Dealers usually sold the product on an exclusive agency basis. The cost of the burner installed varied from $425 for private homes and small furnaces to $2,500 for larger buildings.

Today the company enjoys a national reputation as an outstanding producer in its fields.

7. PRODUCTION METHODS

The Auto-Stoker was made up in three units: a sheet-metal hopper with air blower attached, a patented driving-gear mechanism enclosed in a gearbox, and a cast-iron burner with feed pipe and spiral feed screw attached. The whole mechanism was electrically driven. No special equipment was required for the production of either the hopper or the burner units. The hopper could be produced readily at any sheet-metal works. The burner, feed pipe, and screw, which were heavy castings requiring little finishing, could be produced easily in almost any foundry. The important unit was the driving mechanism. Its economical production required a well-equipped machine shop and heat-treating ovens. None of this equipment, however, needed to be of special design except the dies, jigs, and machining fixtures. The cost department records at the Portland plant showed that the cost of producing the driving mechanism was approximately 50 per cent of the entire cost of manufacturing the stoker.

B. WHY THE AUTO-STOKER COMPANY PLANT WAS LOCATED IN PORTLAND, OREGON

The production of the Auto-Stoker had been started in Portland chiefly because its promoters lived there and had other interests in the city. There was no difficulty in securing skilled workers. The patented part of the stoker was not expensive to ship to the Eastern market, but the hopper and castings were bulky and carried heavy freight charges. Differential prices according to location were charged by the company, since little competition had been experienced initially and the device paid for itself many times over in fuel savings. The management had not been troubled by patent infringement. It expected to cover the field so thoroughly and to operate so economically as to hold its own against prospective competitors. The executives of the company observed that, so far as administration of the enterprise was concerned, the company could operate efficiently from Portland. However, the shipping costs became an increasingly greater problem as the business grew.

Because the company was located on the Pacific Coast, it had the advantage of low shipping rates by water to New York City. The management had considered Chicago as a location for its plant, but shipping costs from Portland to New York by water were very little more than from Chicago to New York by rail. Hence there would be little gained by the Chicago location so far as the Atlantic Coast trade was concerned. Cleveland was more nearly the center of the company's business, and the management had considered establishing its plant there. It had abandoned the idea, however, and instead had made arrangements for Cleveland manufacture of some of the bulky castings for the burner in order to save shipping costs.

An addition to the Portland plant was constructed in 1927, and modern machines were added. These included automatic gear cutters, shapers, and lathes. The plant then covered approximately one-quarter of a city block. A careful departmentization of the production process was worked out. The lower floor was about equally divided between the assembly and shipping department and the machine department, which produced, set up, and tested the driving assembly, the patented part of the machine. The sheet-metal department, the toolroom, and the experimental laboratory were located on the second floor. In the basement were a boiler and furnace fully equipped with testing instruments for experimentation. Castings used at the plant were purchased from local foundries. The plant was well organized and was fully equipped with modern tools. Active research, engineering, and cost departments were maintained.

9. EXPANSION BEFORE THE SECOND WORLD WAR; THE LOCATION PROBLEM

With growth in business the shipping problem had become increasingly vital, and the executives were, in 1928, again considering the problem of expansion. However, no action was taken at that time. Shortly before the Second World War, the company announced the purchase of a plant in Cleveland, Ohio.

This property had been acquired after executives of the company had carefully surveyed the problems involved in its utilization. These concerned the immediate and future use to which the Portland plant was to be put. Should all production be shifted to Cleveland and the Portland plant closed down? Should the Portland plant specialize on the production of the driving mechanism and the Cleveland plant confine its activities to the production of the sheet-metal and cast-iron parts and to assembly of the complete units? Should the Portland plant continue producing as in the past but distribute its output in adjacent territory only and the Cleveland plant become a complete producing unit distributing to its natural geographic territory? Should the Cleveland plant produce its own castings, or should it follow the policy adopted for the Portland plant and purchase them from merchant foundries? Or would some combination of the foregoing possibilities be best suited to the company's situation?

In developing sales of newer types of product there was always the possibility of competition to be considered. This would vary between the different types of installation. A complicating factor was the steadily increasing demand for small home installations of the company's product. It was anticipated that this type of business would be highly competitive. Another consideration was the development of installations for ovens to be used in bakeries, ceramic industries, and the like. These opportunities were in addition to the already occupied fields of private homes, apartment houses, hotels, schools, greenhouses, office buildings, and industrial establishments. The management believed that the business would continue to expand and was prepared financially to meet this expansion.

10. ANALYSIS OF THE SITUATION

Centering of production of the Auto-Stoker Company in Portland, Oregon, clearly was open to question. Major considerations favoring that location included the existence of an efficient, smooth-working plant and organization, availability of a suitable labor supply, low-cost transportation to the Pacific and Atlantic Coast markets, personal preference of company owners and executives for living in the Pacific Northwest, adequate established banking connections, and opinion of the executives that they could manage the business satisfactorily at a distance from the major market. Against that location were the growth of the Middle Western market with its relatively high cost of finished product shipment, competition in home installations in the area most conveniently served from Cleveland, relatively high cost of many materials which had to carry transportation costs from the East to the Pacific Northwest, difficulties of maintaining close contact with the growing market, restriction of the geographic areas that could be economically served from Portland, Oregon, and problems of rendering developmental and technical service for industrial and commercial installations when factory and market were so widely separated. It appears, then, that in the main the urge toward change of location came largely from changes that were taking place in the market or were foreseen as likely to take place.

11. RELATIVE EFFICIENCY OF THE PORTLAND PLANT

Any production change which included lessening the output of the Portland plant was likely to disrupt the efficiency of that unit. This would mean increased cost of production. In view of anticipated increase in competition, cost increase was particularly undesirable. Given the best of plant facilities, labor, and management, it takes time to adjust an organization to smooth-working order. It was expected that any new producing unit set up by the Auto-Stoker Company would be less efficient for some time than the experienced organization at the Portland plant.

12. LABOR SUPPLY

The existence of a skilled, experienced, stable labor supply is an asset to any company. Of particular importance is a dependable and efficient labor group when labor costs constitute a substantial portion of total production costs. Labor supply at the Portland plant was excellent. Skilled labor in that area tended to be conservative and not easily stirred to radicalism. Company workers were mostly native Americans who had families and, therefore, a sense of personal responsibility. Management knew that the company was obtaining relatively high productivity from its labor force and that each dollar expended for wages was yielding a high return in value of product.

The management anticipated no difficulty in obtaining labor of the requisite type and skill in the Cleveland area. There was some possibility that labor obtainable in that area would be somewhat less productive and substantially higher in cost than that available to the company in Portland. Also there was no assurance of labor stability such as was characteristic of the company's Portland employees.

13. TRANSPORTATION COSTS

Transportation costs on raw materials were lower at the Cleveland location than at Portland. Cleveland was nearer the source of supply, both geographically and in terms of transportation costs. Finished product comparison was not quite so simple. Shipping costs to the Pacific Coast market were greater from Cleveland than from Portland. However, the Pacific Coast volume was much less than that which centered around Cleveland. Transportation costs to the Atlantic Coast areas were about the same from Portland as from Cleveland. This is an excellent illustration of the fallacy of measuring nearness to market entirely in terms of miles. Portland is three times as far from New York as Cleveland. Relatively low costs of water shipment through the Panama Canal neutralized the greater distance and made transportation cost to the Atlantic Coast from Portland no greater than rail shipment cost from Cleveland. Cleveland's great advantage as to finished goods transportation cost was in the inland territory between the west and east coasts. This advantage was of particular significance in the light of the trend toward greatest volume expansion in that inland territory.

14. PERSONAL PREFERENCES OF COMPANY EXECUTIVES

The importance of personal preferences of the executives was given careful consideration. They had established themselves in Portland. They preferred to stay there. From a cold efficiency standpoint one might say that such preference should have been of little importance. As a matter of economics that position might hold. Practically, and probably socially, such an economic attitude was not entirely adequate.

In the first place, there was some doubt as to the actual possibility of transferring all these executives. If they were prevailed upon to transfer in face of their opposition, it might result in an increase in cost of supervision. Also there was the question of objectives. One may say that economical production is the matter of first concern, that the preferences, the likes and dislikes, of the servants of the business are of secondary importance. But are they? Do these men exist to serve this business, or is the business there to serve its owners and executives? Practically no business can succeed beyond the abilities of its management, and corporate directors who form the practice of sacrificing the thoughtful desires of employed executives to the seemingly immediate demands of corporate success are building a reputation that is very likely to hamper the enterprise in the future.

15. NEARNESS OF MANAGEMENT TO MARKET

The opinion of company executives that they could manage the business as well from Portland as they could from Cleveland was open to very serious question. During the early years of the company's development they had been able to do so. After that, changes occurred which made the management problem essentially different.

In the home-heating field the severity of competition had increased. Under such circumstances, close contact with the consumer became very important. It is essential to know quickly and accurately what the consumer wants and what he does not want. It is equally important to know what your competitor is doing, and is going to do, to influence what the consumer thinks he wants and does not want. Consumer reactions are frequently influenced far more by what competition has taught the consumer than by logical thinking on the consumer's part.

The Auto-Stoker Company might have been able to gain this desirable contact with the market by moving its marketing and selling organization east and not transferring production. Such action would probably have been better than making no attempt to get closer to demand. It should be pointed out, however, that this gain would be at the expense of isolation of the marketing function from the production function.

In the field of industrial and commercial use of the company's product there was even greater reason for bringing the factory closer to the consumer. These installations were sold with emphasis on continuity of operation of the product. Unfailing service of the product required continuously available servicing. The Auto-Stoker Company could have set up fully equipped servicing facilities for its products in the Eastern territory. There were, however, two objections to this method of meeting servicing requirements: it involved costs of nonresident management, and from a sales standpoint it would be less convincing to many prospective buyers than would the nearby location of the factory itself. Particularly was this true of special installations calling for engineering adaptations of the product to peculiar requirements. Thus, from the sales and service standpoints, there was much to be said for locating the plant close to the market experiencing the greatest growth, the Middle West.

16. INFLUENCE OF THE FUTURE MARKET

The management of the Auto-Stoker Company was well aware that it would continue to be operating in a highly dynamic market. On the Pacific Coast automatic firing devices that used waste from the area's great lumber industry (waste called hog fuel) were becoming popular for both home-heating and light industrial use. Sawdust was cheap, and even the low grades of coal used by Auto-Stokers were comparatively expensive. Means of overcoming the disadvantages of burning hog fuel were being developed, and it was clear that this competition would increase.

In the Middle West low grades of coal probably would remain the cheapest available fuel for a long time. Fuel oil was substantially more costly. Increased availability of natural gas would offer growing competition but at higher cost. Electricity for heating purposes was very convenient but probably would continue to be prohibitively expensive.

In the east coast region there was a steady growth in the popularity of fuel oil. Also natural gas was becoming available. However, the costs of fuel oil were increasing, and transportation costs of natural gas were likely to keep that fuel in the luxury class. For economy and reliability low-grade coal probably would continue to have an advantage, and growth in the use of this fuel in automatic firing devices was likely.

17. THE COMPANY'S DECISION

The decision of Auto-Stoker executives to establish an Eastern major production facility seems sound. A complete plant for the production of the gear mechanism and the sheet-metal components of the burner was set up. Initially castings were purchased, but as volume grew it became economical to produce the required castings, and a foundry was added at the Cleveland location. The Portland facility was maintained to produce for the Pacific Coast market. Aggressive sales effort in this area provided sufficient volume to keep this installation profitable. The research and development work was moved to Cleveland.

The Cleveland plant served the entire United States territory east of Denver. The Portland sales organization was reduced in size, and general sales headquarters with a complete sales organization was established at Cleveland.

Initially the company's Portland financial connections were continued. It soon became clear that it would be advantageous to change to Cleveland banks, and except for local Portland requirements the shift was made. The outcome of this change proved to be highly satisfactory.

The problem most difficult to resolve was management. However, the investigations that preceded the move to Cleveland revealed clearly that if the company was to realize its full future potential, both sales and production had to be moved east. Eventually the discussions of this problem focused on the management's responsibility to the company's stockholders. From this point of view the answer seemed clear. Three of the company's five chief officers elected to stay in Portland. One of the three withdrew from the company; the other two remained to be responsible for the Portland operation. The company's president and sales manager moved to Cleveland. Actually both they and their families adjusted themselves to the new environment quickly and became happy about the change. The additional management requirements at Cleveland were met by the promotion of a younger man, a junior executive in the Portland office who was very glad to go East, and by attracting experienced Cleveland managers to the Auto-Stoker Company. Today none of the people in the old Portland organization are dissatisfied or unhappy about the change.

18. SUMMARY AND CONCLUSIONS

The decision that production in the Portland plant should be continued turned on the relatively low costs of a going organization, the comparatively high productivity of the labor force, and the personal desires of some of the executives to remain in that location. The decision to transfer production to Cleveland was made on a quite different basis. It is doubtful whether unit production costs ever will be lower in Cleveland than at Portland. It is not certain that they will ever be low enough to make the transportation saving of the Cleveland plant to its natural market a net saving. It has been possible, however, to reduce costs of production at Cleveland so that production plus transportation from that plant to the adjacent market is cheaper than production at Portland plus transportation from there to the Cleveland market. But even if this goal had not been entirely attainable, the shift should have been made. The decision rests on belief in the importance of physical proximity of this factory and the market it serves, largely from the marketing standpoint. In commercial and industrial stoker installations, nearness was imperative for sales and service. For the home installation market, nearness was important if the Auto-Stoker Company was to continue to meet and keep ahead of competition within the Cleveland market as it developed. It is this aspect, rather than the seemingly obvious transportation differential, which controls in this case.

Recently the company has started a small export business. Some company executives expect the overseas business to grow. They point to rising standards of living in many foreign nations. They expect that central heating will develop in Europe and that this will bring a demand for automatic firing devices. They have reason to believe that coal will be the preferred fuel. Occasionally a company executive will suggest that Auto-Stoker's long-run opportunity lies abroad.

Nature of Plant Location Problems. While all industrial location problems consist of selecting a place for plant facilities, they appear in a variety of forms. Our consideration of the Auto-Stoker Company was limited to the relative merits of geographical areas. This was because the specific sites within those areas had already been determined. Site within a given area constitutes a distinct type of location problem. Selection of site involves many of the same considerations that are of importance in selecting general locations. Emphasis is likely to be somewhat different. Accessibility of transportation for materials, product, and workers is a common factor. Land cost and construction costs as affected by land characteristics must be considered. Tax rates and assessment values are important. Municipal restrictions on uses to which real estate may be put and local reaction to smoke, fumes, odors, and risks of fire and explosion must not be overlooked. Usually the problem of site selection is not difficult. Methodical, careful analytical approaches to the situation with a forward look to consider the effects of change in any or all of the factors involved will yield satisfactory results.

Another form which the location problem frequently takes is the question of relative desirability of locating where the industry already congregates or away from concentration areas. There is no ready-made answer here. That there are both advantages and disadvantages can be demonstrated by considering briefly labor supply. Where an industry congregates, there can be found trained, experienced labor. At the same time the existence of a number of similar businesses in close proximity creates competitive demand for that labor. Whether or not concentration makes for an advantageous or a disadvantageous labor supply for a specific company can be told only by careful appraisal of the elements in each particular situation. The same is true of many other location factors upon which concentration has an effect. Currently the need for scientific and technical help has had increasing prominence. It is more profitable to study these factors in each specific case than to approach a location problem with a preconceived notion that concentration is likely to affect one element in this way and another element in that way.

Another way in which the location problem is sometimes approached is in terms of the urban versus the suburban or the rural location. Here again, generalizations are of no great profit. The factors upon which choice is based are commonly similar to those taken into consideration in the Auto-Stoker Company case. Procedure along the lines followed there will determine the relative desirability of a particular city location as compared with a particular country site.

At present, there is a definite trend toward rural location. Perhaps the trend will continue. The tying up of industrial with agricultural occupations occasionally assumes a prominent place when this particular trend is being discussed. Just how practical this combination is for any given company has little to do with whatever trend may exist. As conditions change, the relative importance of location factors changes, and, of course, such shifts in importance must receive careful consideration in a search for a location solution. The widespread ownership of automobiles and the resulting traffic congestion have changed the location picture of many businesses insofar as worker transportation and worker supply factors are concerned, although excellent trolley and bus service still is of great importance to many large business units and to some small ones. Motor trucks often have made the existence of a railroad siding at the plant less essential.

During the reconversion and expansion of manufacturing facilities that have followed the Second World War and the Korean struggle, there has been a tendency on the part of some large corporations to decentralize manufacturing activities. The result has been the location of medium-sized specialized factories away from large urban industrial concentrations. It has been hoped that these locations would prove attractive to labor, which might be somewhat less within the constant purview of labor organizations. If this resulted, the daily operating management and supervision of these plants might be somewhat less hectic. It would be foolish to expect that these branch plants would not be subject to organized labor influence. In the last decade there has been a great increase in the negotiation of corporation-wide labor-management contracts. No suburban or rural plant is likely to be beyond the scope of these arrangements. It is true, however, that if labor finds such locations more acceptable than the highly industrialized centers, the tasks of management may be somewhat less burdensome in these branch plants.

Overseas Plants. The truly startling economic progress of Europe, Japan, and Hong Kong since the cessation of Korean hostilities has become of major concern to industry in the United States. Industrial development in these countries, often patterned on the best of our practices, includes the most modern plants and equipment. Expansion of the local markets in and between these countries has enabled many foreign producers to become serious competition for us. We find it increasingly difficult to compete in foreign markets, and many of our foreign competitors are increasing their share of the market here in the United States.

It is a mistake on our part to attribute this growth of foreign industry to labor exploitation. Textile mill workers in Hong Kong and Manila are better paid by far than are most nonmill workers there. They are better dressed, better fed, and better housed than is the bulk of the working population. Their standard of living is superior and is growing steadily. True, hours of work of foreign workers are longer than hours worked here in the United States. The take-home pay is lower than that of our workers, and in many instances foreign manufacturers have lower labor costs because of a combination of low pay scales and reasonably high worker productivity. To conclude from this that socially these foreign manufacturers should shorten hours of work until they are comparable with ours and increase wage rates to our levels is false indeed. In most instances if this were done economic progress in these countries would cease. American manufacturers may anticipate a gradual trend in the direction of the hours and wages levels we have attained, but in the meantime our wages are going up and there is reason to believe that our work week will become shorter.

This text is not the place to undertake an adequate discussion of world-wide industrial progress. But American manufacturers must face up to the new competition, and many of them are doing so. Plant location is one consideration affected. Already manufacturers in the United States are reacting to the startling development of the European Common Market by opening plants abroad. The same is true in lesser degree in the Middle East and some parts of the Far East. More such overseas plants will be developed. In most instances the managements of the overseas units set wages and hours of work that are consistent with local conditions. The author, for one, is unwilling to say that this is labor exploitation and, therefore, is bad. Today many manufacturers are in industries of world-wide scope. Our management thinking must have comparable breadth.

What of the Future? The day may come when plant location problems are radically different from what they are now. However, any drastic difference is likely to be the result of change in the importance of this or that element rather than of some startling innovation that repaints the whole picture overnight. The major problem of the executive responsible for choice of location of an enterprise is to foresee the probable nature of such change and the effects of change during the business life span of the physical facilities involved. Industries in this country have migrated and are still in slow process of doing so. The probable suitability of a location 10 or 20 years hence may well be of greater importance than its suitability today. Consideration of the future within practical limitations is more often than not the critical determinant in the problem of plant location.

QUESTIONS

1. What were the factors management considered in reaching its decision to the Auto-Stoker Company's location problem? What was the significance of each factor? What was their relative importance?
2. Would the same factors, significances, and relative weights apply in all location problems? Please explain.
3. Foundries, newspapers, and laundries tend to cater to local markets. Why?
4. An automobile company usually has several assembly plants located in various parts of the country. Many of these assembly plants assemble bodies from parts shipped from a central location. Why is this? What are the gains?
5. These assembly plants often receive motors entirely or almost completely assembled. Why are not separate motor parts always shipped from the central location to be assembled at the various assembly plants? Why have central plants; why not have all parts made and all assembly done at the assembly plants?
6. For a company manufacturing 6-volt and 12-volt storage batteries that it sells nationally, which would be the better, a single large plant

located near Detroit, or several smaller plants located at such points as New York, Detroit, St. Louis, Denver, and San Francisco?

7. Would Boston, Massachusetts, be a good location for a manufacturer of automobile tires if it sells its product
   a. As original new-car equipment?
   b. Through retail outlets?
   c. Through mail order houses?
8. How is plant location influenced by
   a. The nature of the product?
   b. The characteristics of the production process?
   c. The dynamic characteristics of industrial society?
9. Wherein does geographical location choice differ from site selection?
10. Why do different manufacturers in an industry sometimes tend to locate near one another?
11. Why do industries sometimes migrate?
12. Why is plant location an important business problem?
13. Explain the basis of the statement, "Industrial executives are both fortunate and unfortunate in that the question of plant location is of infrequent occurrence."

PROBLEM 24 FRENCH MOTOR CAR COMPANY

The French Motor Car Company with plant and main offices located in South Bend, Indiana, manufactured passenger and commercial cars of medium price. Cars were produced with chassis standard, or nearly so, in each car. Automobiles were delivered to dealers situated in cities of the United States and foreign countries from the main plant and from an assembly plant at Toronto, Canada. All cars were priced f.o.b. Cleveland. Company officials were considering the advisability of establishing other assembly plants at some points on the Atlantic and Pacific coasts for the purpose of reducing the cost of the car to dealers in these localities. One city selected for analysis was Newark, New Jersey.

The total freight charges on cars shipped to Newark were estimated for the current year at $3,800,000. An assembly plant located at Newark would supply 96 dealer cities. Estimated distribution of cars for the current year to Newark was 78,040. The plant engineer estimated that an assembly plant of sufficient capacity to meet the requirements at Newark would necessitate a capital investment of $3,500,000. This estimate was based on the most up-to-date assembly methods and on the effect of seasonal operation upon annual production. Freight rates from Cleveland to Newark were obtained from the traffic division as follows: average per assembled car, $48.75; average per car disassembled, $16. Loading costs were estimated by the plant engineer to range from $6.50 to $7 on assembled cars and $8.50 to $9 on disassembled cars, the cost depending on the number to be loaded. Costs at assembly plant including fixed charges were estimated at $12 per car, assuming a daily plant output of 280 cars.

In the past, cars had been shipped from South Bend direct to dealer cities in the Newark territory. Driveaway costs from stations of receipt to dealer agencies had been nominal. If an assembly plant was located at Newark, all cars assembled there would be driven from the assembly plant to the dealer agencies. Driveaway costs were approximately 10 cents per mile. The longest driveaway from Newark would be 260 miles.

Does it seem advisable for the French Motor Car Company to erect an assembly plant at Newark, New Jersey?

PROBLEM 25 FLEXUNIT BODY COMPANY

The Flexunit Body Company was a recently incorporated business organized to produce a new type of truck body. Executives of this new company believed that the future success of the enterprise would be influenced substantially by the location of its manufacturing plants. The initial problem was to select a location for its first unit which, in addition to being a manufacturing establishment, was to be the engineering headquarters for the entire enterprise.

The Flexunit Body Company, with moderate capitalization but with ample resources available, was formed in Boston to take over patents and development of a unit truck body. The body could be rolled or lifted onto or off a truck chassis, and similarly could be rolled into a freight car or lifted onto a flat car. These cars would each hold seven units. The technical features were worked out through five experimental installations involving 40 bodies. It was expected that this form of body would eventually play a tremendous part in expediting less-than-carload transportation and in helping railroads to combat the door-to-door advantages of motor truck transportation. It was believed that the manufacture of such bodies would assume great proportions. This removable body would also simplify the shipping problems of users of motor trucks in local hauls where loading and unloading time is considerable. Backers of the company were confident, therefore, of a large local business in each large city.

The bodies were of such design that the sills and certain bottom framework members, cut and assembled from standard structural steel rolled shapes, and the cast bronze and malleable iron rollers, all covered by patents, could be standardized and made at one factory. These parts could be shipped in carload lots to points of assembly. On the other hand, the problem of the bodies proper was that met by truck manufacturers in general; truck bodies are very bulky, and local requirements differ, so that a large number of trucks are sold as chassis only and the bodies are made in local plants, usually independent.

After the earliest stages, the Flexunit removable body was developed in a truck-body plant in the Boston district. The Flexunit bottom frame would fit a large variety of bodies and most standard chassis, the method of adjusting and fastening being one of the patented features; but this adaptability was not without limits. Best results would require some control or some influence over the bodybuilders looking to standardization of body designs to a few forms.

The company was preparing to establish a manufacturing plant, small at first, to do three things: (1) to make frames and rollers, and later when the volume of business warranted to establish a brass foundry, and still later to establish an iron foundry for making its own castings; (2) to make a line of suitable standard bodies for local short hauls, and for demonstration of railroad possibilities wherever such demonstration could be arranged; (3) to organize and develop an engineering department and a developmental department for the purpose of taking care of all the design and developmental work of the company at that time and in the future.

From this beginning the company expected a large growth and a country-wide business. It expected that the earlier and easier field would be in local transportation, but the great growth would be in transportation including a railroad haul of less-than-carload lots. The bodies could be loaded and trucked in one city, railed to another, there transferred to trucks at the freight terminal, and trucked to destination, where the body would be rolled off, unloaded, sent to some shipper in that city for reload, and again railed to another destination.

It was expected that the local business would be more than self-supporting, and that it would supply working funds for the more ambitious plan of truck-rail-truck "piggy-back" transportation. The greatest hopes of the company, moreover, were based upon its belief in the possibilities of the latter. The initial problem was the selection of a city for the first plant, which was to become the engineering base for the whole enterprise.

What are the arguments for and against Boston as a location for the company's first plant?

PROBLEM 26 POTOMAC STUDIOS, INC.

The Potomac Studios, Inc., had recently added to its facilities by purchasing a chain of photographic studios in the Southern states. As a result its laboratories did not have adequate capacity to meet the anticipated requirements of the coming November and December. Officers of the company were faced with the expansion of the present laboratory or the purchase or construction of a new one. The management of the company believed that if the present plant were not expanded the selection of a suitable site for the new laboratory would be an important problem.

The Potomac Studios, Inc., photographers, had been organized for over 60 years. The company had central offices and its laboratory in Brookland, a suburb of Washington, D.C., and 22 branch studios in the District of Columbia, Virginia, Delaware, New Jersey, eastern Pennsylvania, and New York. The company's photographs were priced from $60 to $200 per dozen and were known nationally for their high quality and distinction. Sales had increased rapidly in the last four years and currently were $4,000,000 a year.

Each of the 22 branch studios was managed by an experienced photographer. A traveling force of four supervisors assisted the branch photographers and advised them as to methods by which variety and excellence could be obtained. The plates or films upon which pictures had been taken at the branch studios were sent to the Brookland laboratory and there developed. The proofs were sent to the branch offices for the customers' inspection and selection and then returned to the central office, where the prints were made. As this routine took more time than ordinarily was required by local photographers, it was important for the Potomac Studios, Inc., to do superior work and to maintain an efficient shipping service. The small size and the poor location of the existing shipping and receiving room at Brookland prevented the most efficient handling of the photographs. With the existing space it was impossible to provide adequate facilities for receiving and shipping.

The company had built up an organization at the central plant of 250 employees, 75 per cent of whom were skilled and many of whom were artists. The supply of such skilled employees was limited, and the demand for them was large. Of the total number of photographs taken annually by the company, 35 per cent were taken in November and December. This peak production was met partially by obtaining additional employees and partially by lengthening the hours of work. The labor turnover in the permanent organization was small. A large number of the employees had been with the company for many years. Nearly all the employees in the finishing laboratories lived in Brookland.

The finishing studio of the Potomac Studios, Inc., contained 22,000 square feet of floor space—12,000 in an old apartment house and an adjacent barn, and 10,000 in an office building about two blocks distant. Originally, only a small portion of the apartment house had been used. As the sales of the company increased, additional portions were taken over until finally it became necessary to move the proof and proof retouching departments to the nearby barn and the supplies and the executive offices, including the planning, personnel, and stenographic departments, to the office building two blocks away. Material was transported from the apartment house to the barn over a bridge which connected the second floors of the two buildings. A truck was used to transport supplies from the storeroom to the photographic department. The poor layout of the departments caused much confusion and made it difficult for the company to allocate costs accurately. The photographic processes, however, were of such a nature that an efficient and economical layout could be planned in any ordinary factory building. The insurance rate on the $400,000 of assets which the company had was $1.70 per $100. The photographic processes in the finishing studio used $2,000 worth of water per year.

The Potomac Studios, Inc., had just completed the purchase of 11 studios located in winter resorts of Florida and in the states of Tennessee, Alabama, Mississippi, and Louisiana. With these additional studios, the floor space occupied by the finishing department would not be sufficient to enable the company to meet the seasonal demands of the coming November and December. The Potomac Studios, Inc., intended to continue to expand, probably by purchasing studios located in the Middle West. It was possible that a finishing studio eventually would have to be built in the Middle West or South to serve the studios in those areas. The service manager estimated that additional floor space of 18,000 square feet would be required to provide for the 11 new studios and for the probable expansion in the future.

There were three courses open to the company: (1) it could build a new building, (2) it could purchase a building already constructed, or (3) it could make additions to the buildings already occupied. If the company decided to build a new building it would have to act immediately, as the construction would require at least six months and the installation of equipment and the planning of operating policies an additional two months.

Potomac Studios, Inc., was able to make any capital expenditure which was deemed necessary. The board of directors hesitated, however, to authorize any expenditure in excess of $500,000. Because of the temperamental disposition of the employees and the artistic nature of their work, the board of directors desired that any building which the company built or bought should be located in pleasant surroundings and be artistically designed.

A firm of architects was employed to submit costs of constructing a building upon a 3-acre plot of ground near Brookland which the Potomac Studios, Inc., could purchase for $15,000. This ground was about 20 minutes' walk from the center of Brookland and was the most satisfactory piece of real estate available nearby. The plot was on a level river bank and was capable of some artistic development. The directors believed, however, that, for the most pleasing effects, "the new building should be located upon a hill." The engineers determined that $450,000 would be necessary to construct a plain factory building and that $50,000 more would be necessary to make it artistic. The service manager estimated that $50,000 would be required for new equipment.

The new building would contain two features greatly desired by the company: a fireproof vault for plates and negatives and an auditorium in which the annual meetings of the photographers from the company's studios could be held and which could be used as a recreation center for employees. Of the $450,000 estimate, $60,000 was for the vault and $36,000 for the auditorium. The service manager believed that the resale value of a building of the type specified by the plans would be small. The insurance rate upon such a building and its contents would be 70 or 80 cents per $100. The service manager was uncertain whether springs could be found upon the ground which would supply the quantity of water needed. He knew that several satisfactory water wells had been drilled in the vicinity. It would cost $15,000 to extend the water-supply lines currently used by the company from the Brookland city limits to this property.

A thorough survey of the territory surrounding Brookland indicated that there was only one building of satisfactory size which was for sale. This was a three-story brick building 45 minutes' trolley ride from Brookland. An electric car line which connected with lines from Brookland at a transfer point passed the building. It was possible, however, that the line would be discontinued because of the small number of passengers carried; the Potomac Studios, Inc., had been assured that bus service would be offered if the car line were discontinued. The carfare on the line was 25 cents each way. Because of the carfare, the service manager believed that if the three-story brick building were used an annual increase in salary of at least $125 per person would be necessary for the employees who received less than $50 per week; about 50 employees were in this class.

The building had been constructed and occupied by a manufacturer of musical instruments. It was admirably located in the center of a 15-acre plot and on the top of a small hill overlooking a meadow, a brook, and distant woods. The building was covered with ivy and had a winding road approaching it from the main highway. There were two tennis courts and a wooden building satisfactory for recreation purposes on the grounds. A spring in the boiler house supplied sufficient water for the company's requirements. The insurance rate would be about 90 cents per $100. It would be necessary for the company to operate a lunch room for employees and executives. Public transportation from the plant to the homes of the employees would be inconvenient during November and December, when the employees worked overtime. An excellent highway from Brookland ran past this site. The building could be purchased for $250,000. In addition, $10,000 would be necessary to construct a vault in the basement of the building and $50,000 would be required for equipping the entire plant. Construction of a parking lot would cost $20,000.

The service manager believed that at a cost of $40,000 additions to the company's existing buildings could be constructed which would enable the company to meet the peak requirements the coming November and December. Little if any of this expenditure could be recovered in case the buildings were sold for other purposes. The addition would provide temporary relief only.

QUESTIONS

1. Should the Potomac Studios, Inc., build a new building, purchase the old building, or make additions to its existing buildings? List the arguments for and against each site. Rank the arguments for and against each site in what seems to you to be the order of their importance. Explain your final choice of site.

2. Do you think a better plan would be to set up finishing laboratories in several parts of the country? Please explain.

11
PLANT LAYOUT

SIMONDS SAW AND STEEL COMPANY (B)

1. A LARGE MANUFACTURER OF SAWS AND KNIVES ACHIEVES AN IMPROVED LAYOUT OF PLANT EQUIPMENT

The Simonds Saw and Steel Company, one of the oldest and largest manufacturers of circular wood and metal saws, machine knives, band saws, band knives, files, and hack saws in the United States, consolidated its two plants in Fitchburg, Massachusetts, and its Chicago plant. All three of these plants had been laid out in general for functional operation. The new consolidated plant was laid out for a modified line production.

2. FIXED ASSETS

The selection of equipment for use in the production process and the arrangement of this equipment in the plant have considerable effect on the profits of a manufacturing establishment. Selection and layout problems are somewhat similar to plant location problems in that they tend to constitute long-time commitments.

When the manufacturer prepares a statement to show the condition of his business, he lists among the things to which the business holds legal title a group of physical possessions to which he gives the caption "Fixed Assets." Plant, machines, and equipment are characteristic items of this category. The heading "Fixed Assets" seems to endow these items with the quality of permanency, and that is the characteristic which the average reader of a financial statement ascribes to them. They are the permanent, tangible attributes of the manufacturing business which any claimant against that business, be he creditor or stockholder, may see, touch, and observe at any time if he will go to the point at which these physical aids to the production process have their place of fixity.

3. FIXED ASSETS THAT ARE NOT FIXED

Our interest in fixed assets lies in their usefulness in production, and from that point of view there is no such thing as a fixed asset in the sense that it does not change or disappear. Essentially, plants, buildings, and equipment are just like all other assets used in the production process. They are continually changing, being used up. The essence of the productive process is conversion of assets, be they machines or raw materials, into marketable goods, usually of an entirely different form and designed to serve an entirely different purpose.

4. DEPRECIATION AND OBSOLESCENCE DEFINED

The major difference between machines and raw materials from the standpoint of production is that the former are usually converted into finished product more slowly than are the latter. We define depreciation as the physical wearing away of a fixed asset. Obsolescence we define as the economic wasting away of a fixed asset. Depreciation has to do with the decline in mechanical ability of a machine to produce. Obsolescence refers to the decline in efficiency of operation of a machine as compared with some other newer device of greater productivity. We are concerned with obsolescence only when it takes place at a more rapid rate than does depreciation.

5. DEPRECIATION AND OBSOLESCENCE A PART OF THE PRODUCTION PROCESS

It is important to know the meanings of these two terms and their significance. It is far more important for an understanding of the basic principles of production to realize that depreciation and obsolescence of operating machines are nothing more or less than the conversion of fixed assets into finished product.

6. IMPORTANCE OF THE RATE OF DEPRECIATION AND OBSOLESCENCE

A major problem of the manufacturing executive is to keep his costs of production low. Frequently some of his largest costs are those which arise from the utilization of machines in processing. These costs include depreciation, obsolescence, repair, maintenance, taxes, insurance, and interest. Depreciation and obsolescence assume major proportions in this list. Under such circumstances much executive attention is given to the rate at which machines are converted into finished product. If obsolescence is a large item of cost, the more rapid the rate of conversion of fixed into current assets the better. In other words, the manager will wish the machine to depreciate, to wear out, as quickly as possible

—provided that the wearing out is actually a conversion of the machine into marketable product.

Even when obsolescence is not an important element of cost, it may be desirable to depreciate a machine by productive wear quickly. When wage rates are relatively high and output is in proportion to the speed of the machine, obviously the more rapid the machine operation, the lower will be the labor cost of the operative per unit of product. Much cotton textile equipment in use today was designed at a time when wages were lower than they are now. In consequence, it was built to run at speeds entirely unsuited to modern, high-wage conditions. The low speeds at which these machines have been run have given them a long physical life, but the rate of conversion of these machines into cloth has been far too slow for present-day high wage rates.

It is important to realize that a consideration of machine speeds in relation to wage rates in any specific case must concern itself with many factors; the type of wage payment is an example. Hourly rates and piece rates will have quite different effects. The ability of the operative to influence the rate of output will likewise be important.

The relative slowness with which buildings and equipment are commonly used up in processing makes errors in their selection for production costly. Ordinarily machines and equipment are used up more rapidly than factory buildings. Nevertheless, in making new installations or replacements, consideration must be given to trends within the particular industry involved, effects of cyclical swings in business, seasonal fluctuations in volume, technical progress, and many similar influences in addition to the usual consideration of immediate cost to produce with the new equipment as compared with the old.

7. PLANT LAYOUT TYPES

Proper plant location, advantageous site, and suitable equipment are important business considerations of the industrial executive. In operation, the combination of these factors should be such as to make possible plant and machine layout which will ensure rapid and economical process flow and low labor, inventory, supervision, and production control costs. Plant layouts are of two general types, namely, line and functional. Neither of these types is commonly found in pure form. Most plants incorporate both in some degree, with emphasis placed on one or the other.

8. FUNCTIONAL LAYOUT

A plant is said to have a functional layout when each type of operation is performed in a separate department on all types of product. For example, consider a factory manufacturing taps, drills, reamers, and milling cutters. All these types of tools have four principal operations in common, *i.e.*, they are all turned, milled, heat-treated, and ground. For a functional layout, therefore, the factory would have a turning department, a milling department, a heat-treating department, and a grinding department, through each of which all four types of product would pass.

9. LINE LAYOUT

A plant is said to have a line layout when each type of operation is performed in such sequence as to require no backtracking or deviation of material. For a line layout in the factory manufacturing taps, drills, reamers, and milling cutters there would be a reamer department made up of groups of machinery devoted entirely to work on reamers. A group of lathes to turn reamer blanks would be followed by milling machines to square the shanks and others to mill the flutes, then hardening and tempering furnaces continuously maintaining the correct heats for reamers, and lastly, grinding machines to do the finishing. Other groups of machinery would be set up in a similar manner for the other products. This line layout would thus comprise a tap department, a drill department, a reamer department, and a milling cutter department.

10. DEVELOPMENT OF THE SIMONDS SAW AND STEEL COMPANY

In general the plants of the Simonds Saw and Steel Company had been laid out functionally. In part this had been the result of years of development and growth.

The company was founded in Fitchburg, Massachusetts, in 1832, for the manufacture of mowing-machine knives. It was managed and controlled by the Simonds family from the first. From time to time new lines of product were added, and during 1905 and 1906 a new plant was erected on North Street in Fitchburg. The size of this plant was increased as additional production space was required, until it had reached a total of approximately 300,000 square feet of floor space. The following items were the principal products of the North Street plant:

Solid tooth circular wood saws
Inserted tooth circular wood saws
Solid tooth circular metal saws
Inserted tooth circular metal saws
Dado saws
Planer saws
Saw bits and shanks
Narrow band saws
Band knives
Circular cutters
Planer knives
Paper knives
Hog knives
Veneer knives
Tobacco knives
Printers' steel rules

In 1892 the management, realizing that most of its customers for wide band and crosscut saws were located in the northern and southern central states, had opened a factory in Chicago for the manufacture of those products. This was considered a more desirable location than Fitchburg for supplying the lumbering interests in Louisiana, Mississippi, Wisconsin, and Minnesota. Production of these items in Fitchburg was discontinued at that time.

In 1905 the Fitchburg File Company had been purchased by the Simonds Saw and Steel Company. The product of the Fitchburg File Company, files and hack saws, combined well with the company's other lines from a distribution point of view. In addition, the Simonds Saw and Steel Company was a large user of files and felt that it was more economical to make them than to buy them.

11. METHODS OF DISTRIBUTION

The products of the Simonds Saw and Steel Company were distributed directly by the factories and by branch offices located at various points throughout the United States and Canada. Salesmen worked from these branch offices and sold directly to consumers as well as to dealers. Several small shops for the repair and servicing of saws were maintained at strategic points in connection with the branch offices. These shops were equipped to make up an occasional circular saw from hardened blanks when special service was required. Their principal work, however, was refitting and retensioning saws returned for that purpose by the customer. A complete manufacturing branch plant was maintained in Montreal.

12. SEASONAL ASPECTS OF THE BUSINESS

Wood saws were a decidedly seasonal product, being in greatest demand during the winter. Metal saws were less seasonal, and the demand for many of the knife lines was unusually even throughout the year. The complete Simonds line, therefore, was not badly balanced, although some slackening in production was usual during the summer months.

13. THE NORTH STREET PLANT LAYOUT

The North Street plant in Fitchburg was the largest of the company's plants, and its layout and organization were typical of the condition which obtained in the others. This plant was laid out in general along functional lines. It had a heat-treating department, where the whole product was hardened and tempered; a milling department, where most of the milling machine work was done; a smithing and straightening department, where all types of saws were tensioned and blocked and where knives were straightened; and several other departments devoted to one or two functions applying to several of the products. Additions of new products from time to time had complicated the organization, and, in several cases, parallel departments had been set up to perform the same type of operation on newly added lines of product. For example, one grinding department finished circular wood saws and large circular metal saws, whereas another grinding department finished small metal saws, and a third department finished knives. With the gradual growth of the plant and increase in product lines, it had been difficult to avoid these duplications in departments.

Another complication had been the tendency of nearly all foremen to acquire as much responsibility as possible by adding allied operations to their departments. This tendency had been combated to a large extent, but there had grown up, nevertheless, a few instances where departments with one main function included several varying side lines.

14. OBJECTIONS TO THE NORTH STREET LAYOUT

As a result of this plant layout, the management had been faced with increasing production difficulties as volume of business grew. It was impossible to route material through the shop effectively because successive operations were widely separated (see Exhibit 1, pages 284 and 285). Shop transportation costs were high, and much difficulty was encountered in keeping track of orders. All these factors added to the overhead expense. Company executives had given this problem much consideration and decided to consolidate the two Fitchburg plants and the Chicago plant in a new building which company engineers laid out for straight-line production. They believed that the increased production efficiency and decreased overhead would more than offset the expense of a new plant. Operating results in the new plant have proved the wisdom of this decision. Costs have been reduced.

15. OBJECTIONS TO LINE LAYOUT

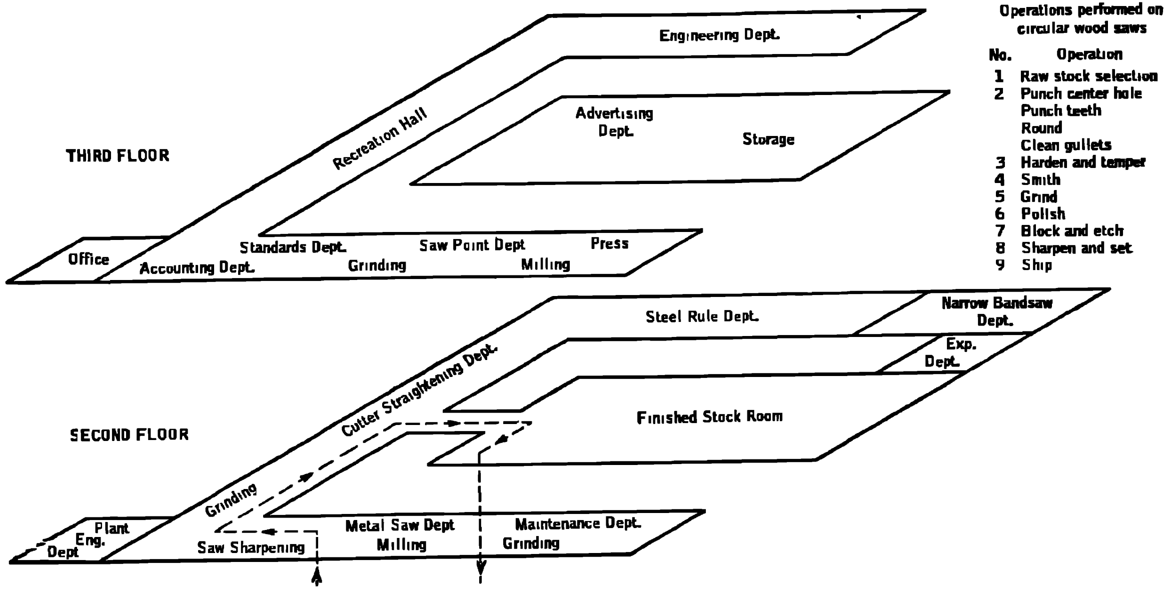
A vital factor in this change from functional to line layout was the necessary reorganization of the factory personnel, particularly the foremen. The management recognized the fact that the heart of its organization was its department foremen. All these men had been with the company for many years, in two cases more than forty. They were all of unusually high caliber and had collected under them superior groups of mechanics. Unfortunately most of the foremen were highly specialized experts in one functional operation, such as grinding, milling, presswork, or heat-treating. The management's problem was utilizing these foremen in a factory laid out for line production. Under this new organization, failure of a foreman would be due to the fact that he had been placed in a wrong position rather than to any lack of personal ability. Capability of the company's foremen had been proved by years of trial.

Under the old functional layout, one machine was usually used to perform similar operations on a number of different lines of product. One type of product alone did not provide enough work to keep the machine busy all the time. Therefore, in changing to a line type, the management was faced with the possibility of having identical machines in two or more production lines which were busy only part of the time.

16. DETAILS OF THE NEW LAYOUT

The company's engineers developed a layout wherein the product flow was from the raw material storage at one end of the building to the finished stock storage at the other. Production was carried on in seven lines comprising the entire output (file, hack saw, saw point, knife, circular wood saw, circular metal saw, and band saw), and progress of work was assisted as far as possible by automatic conveyors.

Exhibit 2, pages 286 and 287, shows the proposed machine layout in the new plant. Exhibit 3, pages 290 and 291, groups the machinery



Operations performed on circular wood saws

No.	Operation
1	Raw stock selection
2	Punch center hole
	Punch teeth
	Round
	Clean gullets
3	Harden and temper
4	Smith
5	Grind
6	Polish
7	Block and etch
8	Sharpen and set
9	Ship

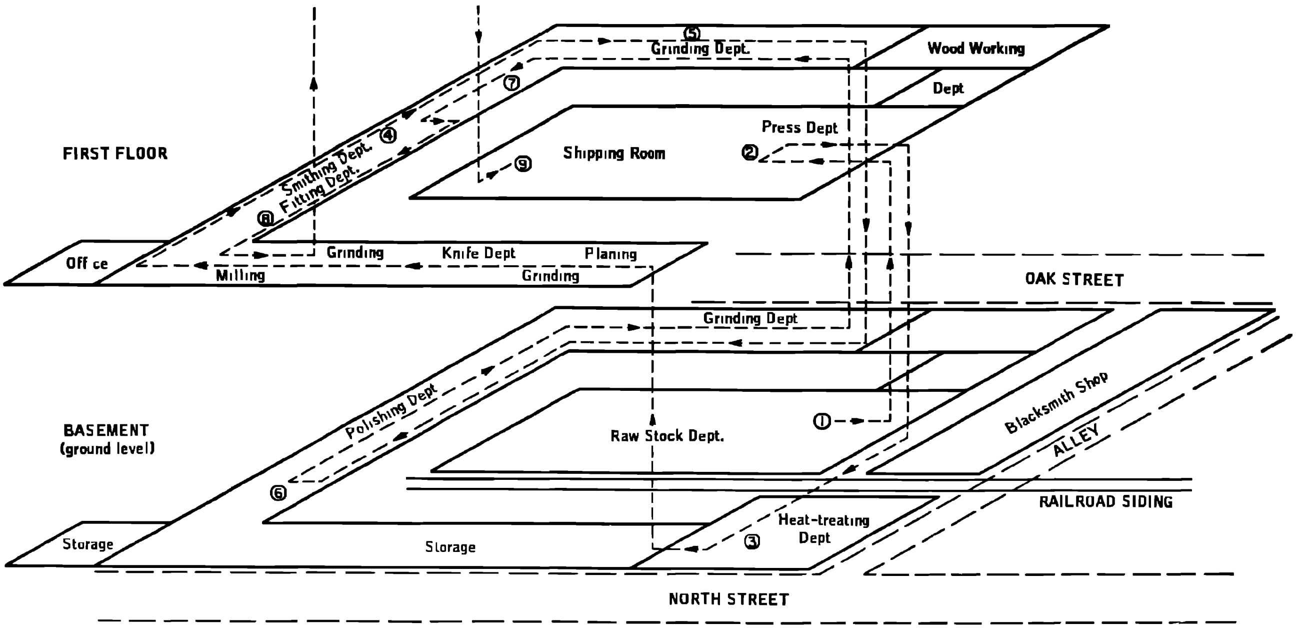


Exhibit 1. Simonds Saw and Steel Company. Diagram to Show the Effect of Functional Departments in the Old Plant on Process Flow of Circular Wood Saws.

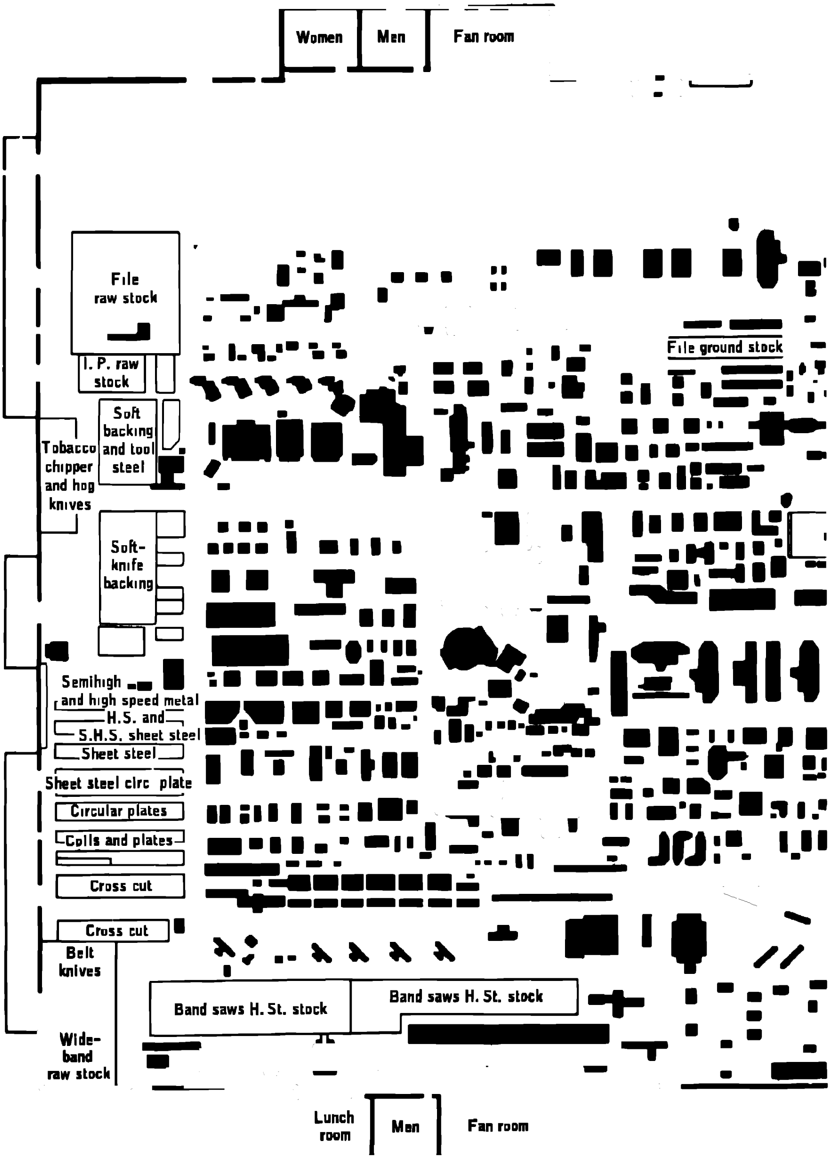
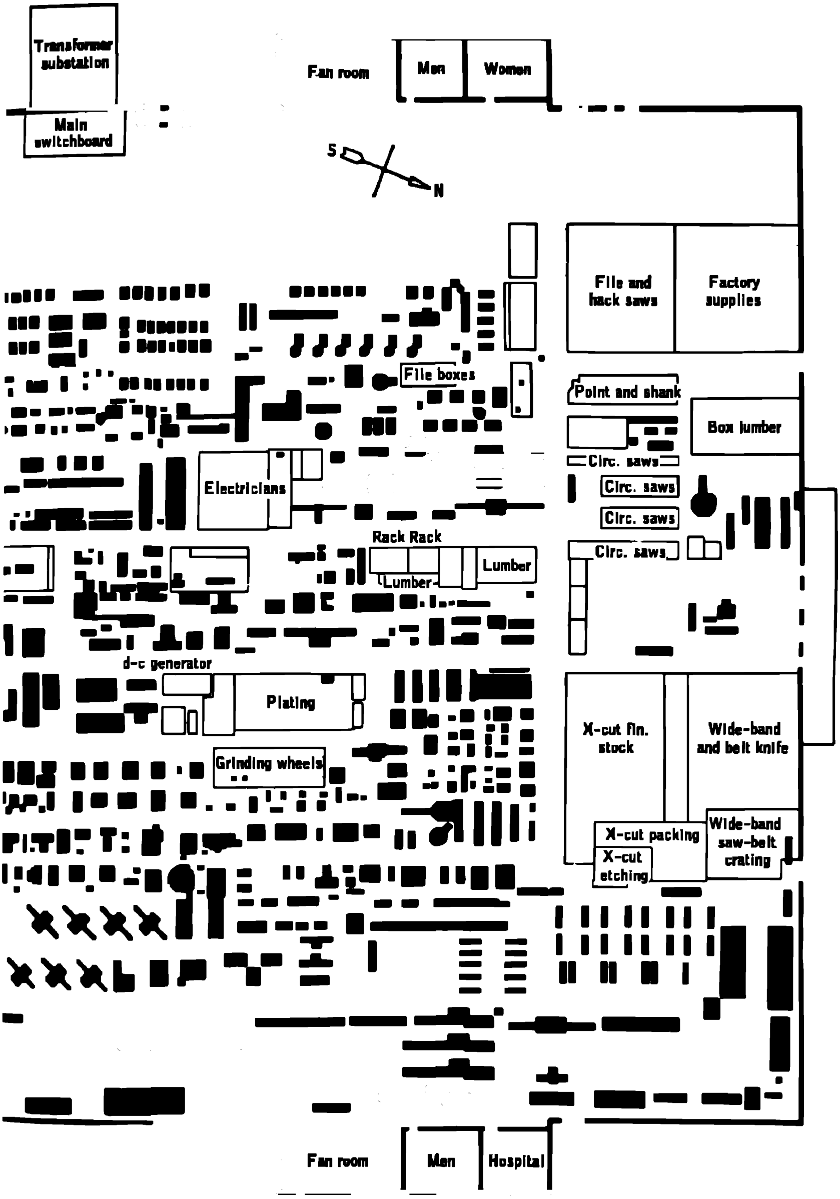


Exhibit 2. Simonds Saw and Steel



Company. New Plant Layout.

shown in Exhibit 2 into sections within which machines perform similar operations and indicates flow of the seven production lines through these sections.

17. DESCRIPTION OF THE NEW BUILDING

The new layout was housed in a one-story building 360 by 560 feet, with no partitions. The building was without windows of any sort. The lighting fixtures were a new development of the General Electric Company, combining the mercury-vapor arc of the Cooper-Hewitt with large incandescent lamps. The effect produced was that of sunlight. Temperature and humidity were regulated by means of air washers and steam coils through which currents of fresh air were circulated by large ventilating fans. This apparatus could be controlled to give uniform temperature and humidity at all times both in winter and in summer. A roof of sound-absorbing material and installation of sound-absorbing baffles around the noisiest machines deadened atmospheric vibrations. Roof ventilators, ventilating curtains in the roof trusses, and insulated hoods connected with the flue gas exhaust system made the area occupied by the heat-treating equipment as comfortable as any other part of the plant.

An observation walk was installed in the building. It was raised 11 feet above the working floor and made a complete circuit of the room at a distance of 90 feet from the walls. This permitted the observation of the plant by supervisors and visitors without in any way hindering production. Railroad sidetracks were built to the delivery and discharge doors at the ends of the building.

It was the management's purpose to produce uniformly agreeable working conditions and, in return, to demand a high degree of production efficiency from its workmen.

18. EFFECT OF TWO-SHIFT OPERATION

The new plant was operated 80 production hours a week. There were two eight-hour shifts a day, five days a week. The Fitchburg plants had been operated 50 hours a week, and since the object of the change was to increase operating efficiency rather than to increase the volume of production, the more intensive utilization of the new plant made it possible to eliminate much of the company's existing equipment. Greater production efficiency of the new line layout has further reduced the equipment necessary to maintain output.

19. SUMMARY AND CONCLUSIONS

Nature of the New Layout. The layout is a combination of line and functional types. The operating departments are functional departments. They are so ingeniously arranged in relation to one another as to provide for practically straight-line flow for each product starting from raw material storage and continuing through the various processing departments to finished stock. The nature of the products and of the operations required in their production made it possible to do this without interdepartmental backtracking or much duplication. A few functional departments were duplicated. An example is heat-treating. Files are heat-treated twice. Rather than backtrack after the cutting operation, a second, small heat-treating department was set up in the direct line of production flow for files. However, such departures from single functional departments were rare.

Within each functional department equipment is arranged to facilitate straight-line product flow. In the large heat-treating department in the southern end of the plant, the equipment used to anneal files is located at the west side of the department because files tangs are formed in the west end of the adjacent forging and welding department and move into the heat-treating department at the nearest point. This is the principle employed in laying out the equipment within each functional department. The result is a great shortening of the distance traveled by any item in its production, with complete elimination of costly vertical transport. Comparison of Exhibits 1 and 3 will show clearly this improvement in the case of circular wood saws.

Advantages of the New Layout. In addition to lower indirect labor costs, resulting from the shorter distances and the possibility of using conveyor equipment, the proposed layout presents other substantial advantages. Shorter transport lessens the time required to produce an item and therefore reduces work-in-process inventory and makes more rapid the turnover of capital invested in work in process. Supervision and production control are easier because routing is largely predetermined by the layout, and less moving instruction and follow-up of orders in process are required. This enables the company to make deliveries more quickly and surely, for the time required to process an order is known more accurately. Finished goods inventories can be reduced safely because of the shortening of processing time and greater accuracy of forecasting it. The layout lessens the possibility for orders to become lost in process or for workers to cover up defective work. Decrease in work-in-process inventories and

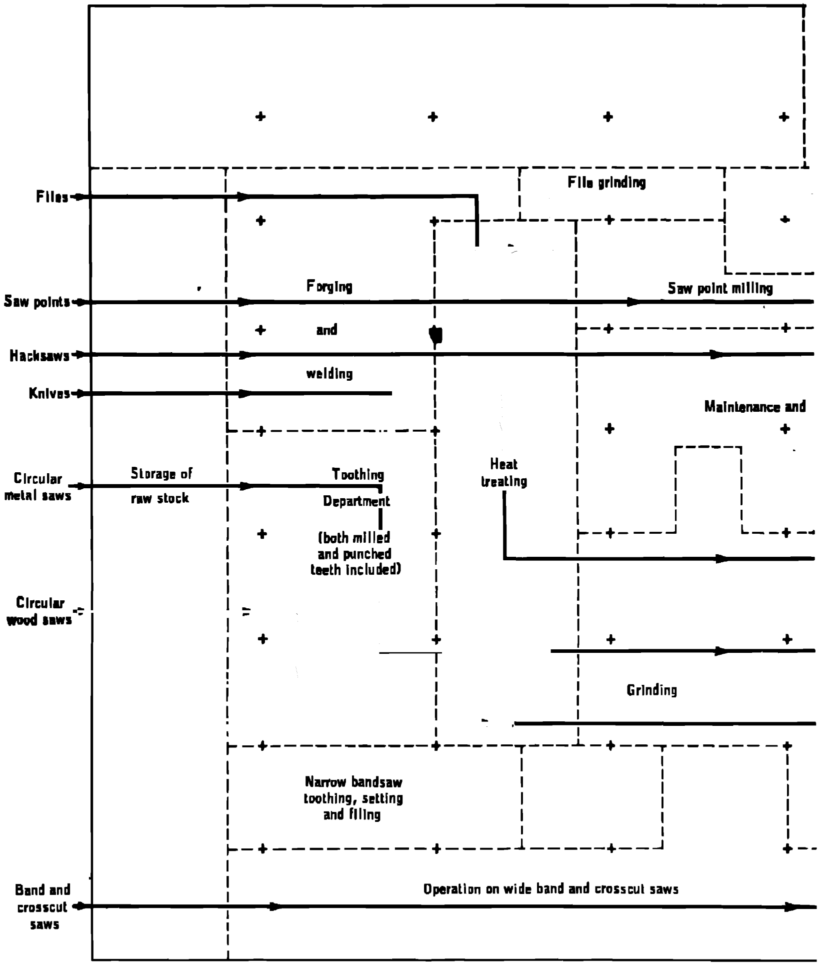
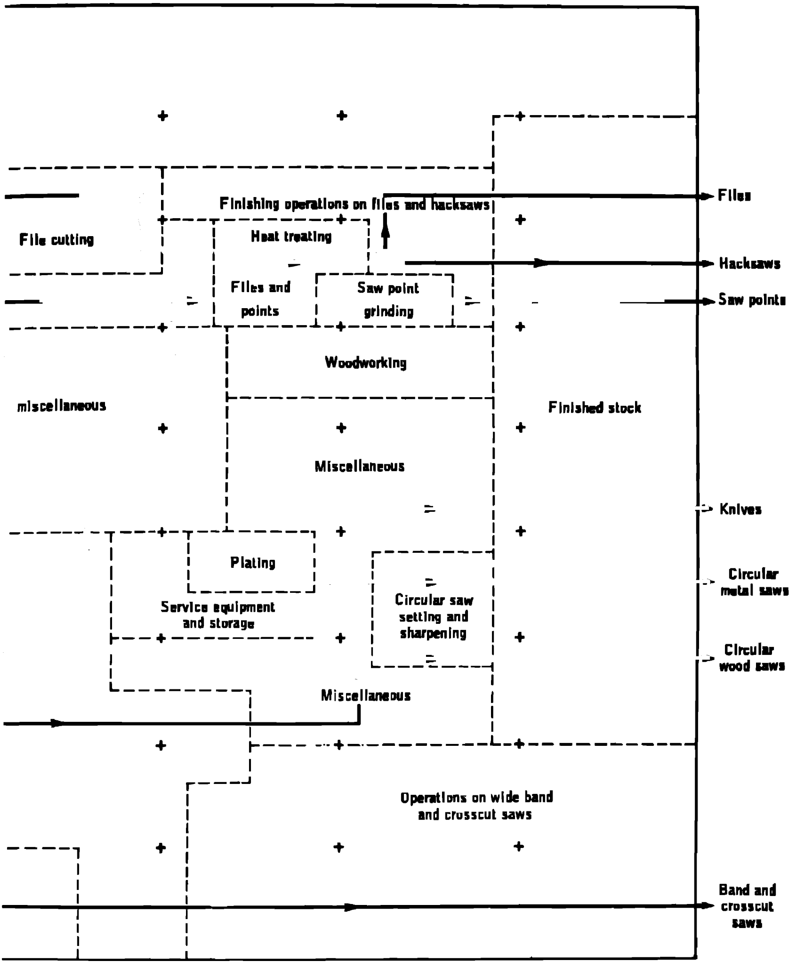


Exhibit 3. Simonds Saw and Steel Company. Diagram to Show Groupings of Machines in the Groupings.

shorter transportation made it possible to reduce floor space without restricting output capacity. This has resulted in less plant depreciation and lower costs of heat and light, insurance, taxes, maintenance, and watchman service. These gains are intensified by the change from one to two operating shifts. Two-shift operation also has cut down the amount of equipment required and reduced operating and ownership costs.

The unusual way in which functional and line layout types are combined in the new layout tends to overcome one of the character-



New Plant and Flow of the Seven Principal Lines of Product Through These Machine

istic difficulties of line operation. Typically line layouts tend to be less responsive to volume increases and decreases than do functional layouts. This problem is solved to considerable degree in Simonds Saw and Steel Company's new plant. Any seasonal increase in circular wood saw demand, for example, usually can be accompanied by decrease in hack saw, knife, and circular metal saw production. When this occurs an increased amount of heat-treating capacity is switched from these later items to circular wood saw heat-treating without disturbing the line of flow of any of the items concerned. These give-and-take switches can be made even to meet daily fluctuations in production requirements of the several item lines flowing through a common department. Such flexibility is unusual in line layouts.

The particular layout devised gains many of the advantages of line layout without sacrificing certain of the desirable features of the old functional arrangement. One of the greatest gains from functional organization is the skill it engenders in both workmen and foremen. Simonds Saw and Steel Company executives recognized the importance of retaining the skills built up in the old plant. The new layout makes this possible. Workers are doing the same jobs that they have done. Foremen perform no substantially new tasks of supervision. This characteristic of the new layout is evidence of the thoroughness and care with which company engineers devised a plan suited to the needs and characteristics of the situation it was designed to meet.

Questionable Aspects of the New Layout. The layout does not entirely escape adverse criticism. The functional department is more adaptable to change in product design and type. Machines are more likely to be usable for a number of purposes. Their arrangement bears no close relation to any one product. Labor is more likely to be able to operate different types of machines or to do a variety of jobs on any one piece of equipment. The functional department is usually far more able to change from the making of one product to the making of a substantially different one, or to effect quickly and inexpensively changes called for by alterations in product design. The new plant suffers somewhat in this respect.

Usually it is not difficult to increase the capacity of a plant which is made up of functional departments. New machines can be added, and increased floor space can be arranged. It is far more difficult to increase the capacity of a line production plant. In line processing, the capacity of each machine must be related to the capacities of every other machine on the line. A line can be no faster than its slowest unit. To increase the output of the line, various alterations usually must be made. Of course, it is possible that the only change required would be an increase in the speed of every unit in the line. Such adaptability is rare, however. Usually it will involve a combination of many things: some machines will be run faster; some machines will be replaced by machines of greater capacity; some operations will be brought up to the new rate by duplicating the equipment at that point. Inevitably the whole layout will have to be readjusted. This is obviously a more difficult and costly procedure than the relatively simple additions of machines and floor space for functional departments.

All these generalizations apply to some extent to the Simonds Saw and Steel Company situation. However, the designs of the company's products are relatively stable, and layout difficulties of change have been foreseen and protection provided in the new layout. Within each department there is more of functional layout than of strictly line layout. Volume change therefore can be accommodated to a considerable degree without incurring high costs of production. If it becomes desirable to expand capacity, it can be done within the departments in much the way that functional departments usually expand. A limiting factor here, however, might be difficulty in obtaining the needed additional floor space without upsetting interdepartmental location relationships. Such drastic volume changes seem unlikely.

Because the departments in the new plant are essentially functional, reasonable changes in product design can be accomplished without great difficulty. New sizes and designs of files can be introduced readily and old items dropped without substantially disturbing layout.

The layout makes some provision for addition of entirely new products in the unused space along the west side of the building. Expansion or change of this nature is restricted, however.

Analysis of the foreseeable requirements of this company would lead one to the conclusion that as far as layout is concerned the new plant provides for essential flexibility. The carefully interrelated arrangement of departments in terms of the process sequences of the various products would be a limitation. However, the company does not make a style product or a product which is likely to be subject to rapid technological change. The new plant and its layout have justified fully the risks inherent in the questionable aspects of the layout.

Problems Growing Out of the Change. One must not overlook the fact that the change required large initial outlays of money. Just what weight this should carry in making an appraisal of this case cannot be determined here; requisite information is not available. It is not likely, however, that so obviously important a matter was overlooked.

The new layout gave rise to certain supervision problems. A foreman's job was just what it was before, with one difference. The scheduling of work into and out of the department is no longer a responsibility of the functional department foreman. To secure the gains inherent in the proposed layout, centralized authority for scheduling was required. This is because in most instances several products go through each operating department. If the work is to flow smoothly along the lines planned, someone with a knowledge more extensive than that of any one departmental foreman has to have the authority to say what is to be done in each department and when each job is to be completed. Such centralization of scheduling impinges on the authority exercised by the departmental foreman under the old layout. This change is imperative, and while it may not seem radical it has been somewhat difficult for some foremen to adjust themselves to the new status. In this one respect the foreman no longer plans. His job is to execute the orders of a central planning department. This can be more of a mental wrench than offhand judgment would anticipate. Most of the foremen have adjusted to the change in their responsibility and authority. They still have the same workers under them, are responsible for the same process techniques. In two cases foremen found central scheduling "too restrictive," but most supervisors accepted their new situation in this respect rather well.

One change in the managerial team eventually was found necessary. A product supervisor was placed in charge of each product line. In talking with one of these men, the author found that the exact responsibility and authority of the position are somewhat nebulous. The product supervisor is responsible for "seeing to it that his line satisfies the needs of the line's customers and that the customers' orders are properly filled and reach them on time." When questioned as to the authority the product supervisor has over operating personnel, such as foreman, the answer was "none; we work by persuasion." Organizationally this situation seems less than completely satisfactory. Nevertheless, "it works" and customer service now has become excellent.

Conclusions. The layout of the new plant is superior to that of the old. It is superior to either a pure functional or a pure line layout for this company. It has resulted in substantial production economies. It involves certain risks. It gave rise to problems. Considering the nature of this company's product, the character of its demand, and the types of process involved, the layout devised by company engineers was a distinct advance.

Relation of the Process to Plant Layout. The process of manufacture largely governs layout. In a plant which specializes in the continuous production of a few standard products, it is natural that machine groupings should be of the direct line type. When a large and diverse line of products is intermittently manufactured, the advantages of this type of organization are more than offset by its weaknesses, and the functional type of layout seems best fitted to process requirements.

The Efficiency of Straight-line Layout. Given suitable processing conditions, "straight-line" layout has many advantages. There is a tendency for work to proceed rapidly from operation to operation, with the result that the total time required for production is lessened and investment in work in process is lowered. The planning of work schedules and the movement of work from operation to operation are facilitated. Once a product is started at the beginning of the line, it tends to progress without interruption from operation to operation, and without the supervisory attention required in the functionally arranged plant. The straight-line method also has the advantage of eliminating backtracking of work in process and rehandling of worked materials. It is costly for a product to retrace its path during the process of production, and it is likewise expensive to handle and rehandle materials and work in process. The straight-line type of setup often utilizes many automatic materials handling devices, such as gravity and power conveyors, which tend to reduce handling costs to a minimum. The extent to which straight-line layout facilitates the use of handling equipment makes it economical of floor space, a saving which comes through elimination of the wide aisles required for hand trucking and storage space at the machines. Once a direct line layout is properly effected, bottlenecks do not develop, and the bottleneck is one of the major problems of the plant organized into functional departments. One further advantage of direct line layout should be mentioned. It is common practice so to lay out and locate production lines that the final operation on a part occurs in close proximity to the point at which the part enters into the assembly process. This yields additional savings in low inventory, handling, and supervision costs. The development of the flexible overhead monorail, however, has brought physically separated points within a plant into close contact so as to lessen the need for production lines emptying directly on to the assembly floor.

Objections to Straight-line Layout. The most unsatisfactory characteristic of direct line layout is its relative inflexibility. Changes in product necessitate change in the layout of production lines. Even minor changes in design, improvement in methods of processing, or changes in raw materials used may require a rather substantial change in machine arrangement. Unless production volume between changes is relatively large, such alterations are expensive.

Fluctuations in the rate of production likewise make line manufacture costly. When equipment is not occupied in producing the particular part or product for which it is laid out, it is idle. Its layout makes it essentially a special-purpose device, and as such it is subject to all the objections to specialized equipment for purposes of diversified manufacture.

Advantages of Functional Layout. The functional type of equipment arrangement is strong where the line type is weak and weak where the line type is strong. It adjusts itself to change in product and design of parts and in volume much more readily than does the line type. Often a higher percentage of productive machine operating time is obtained. Where the output is varied, it is often possible to accomplish a certain volume of finished work with less investment in equipment. Sometimes skilled workers can be utilized to better advantage, and in the opinion of many foremen, skill is likely to be greater and to increase in the functional department.

Disadvantages of Functional Layout. At the same time, the functional department possesses certain definite weaknesses. Control is more difficult, and supervision inside and outside the department is more costly. The work of each department and of each man and machine within each department must be planned and supervised for every hour of every day. Delays are much more frequent, and predetermination of results, though usually possible, is difficult and therefore costly. In addition, the functional department possesses little of the machine-pacing incentive to labor productivity which is frequently found in the line type. Materials and work in process are commonly moved from machine to machine, from operation to operation, by hand or by truck. Thus transport is relatively costly and much more space is required for aisles and temporary storage.

In brief, one may say that line type of layout has the advantage of high productivity with little supervision at low cost of operation—given suitable conditions. Functional layout has the distinct advantages of relatively great adaptability to change and a high degree of machine utilization even under rapidly varying conditions.

QUESTIONS

1. In what respects is the layout of the new plant superior to the old layout?
2. Has the new layout any weaknesses, objections, or dangers?
3. Do you think the management was wise in adopting the new plant layout?
4. What is the so-called line type of layout?
5. What are its advantages?
6. What are the objections to the line type of layout?
7. Under what conditions is the line type of layout likely to result in low costs of operation?
8. Explain the functional type of layout.

9. What are its strong points?

10. What are its weaknesses?

11. Under what conditions is functional layout likely to give low operating costs?

12. How would you characterize the layout of the new Simonds Saw and Steel Company plant?

13. Under what circumstances is the type of layout developed for the Simonds Saw and Steel Company likely to be most advantageous?

14. In what ways is this new layout flexible? Inflexible?

15. Why is it desirable to keep inventory of work in process at a low level?

16. What is depreciation? Obsolescence?

17. What is the business significance of depreciation and obsolescence?

18. Why did the management find it necessary to add product line supervisors to its executive staff after it moved into the new plant?

PROBLEM 27 AJAX AMMONIA COMPANY (B)

The plant of the Ajax Ammonia Company was seriously congested. Inefficient layout, unused equipment, and lack of "plant housekeeping" prevented the work from flowing easily and smoothly. The management was considering moving to a new location.

The Ajax Ammonia Company was a small company producing ammonia for household use. It owned a small 70- by 80-foot four-story building and employed, outside the office force, 15 relatively unskilled men under the direction of one foreman. The process of manufacture consisted of the mixing of chemicals and an ammonia solution with water. This liquid was then bottled, and the bottles were labeled and packed for shipment.

The crates of empty bottles (see Exhibit 1) were unloaded from the cars and usually stored on the first floor temporarily until they could be taken up on the elevator to the fourth floor. There they were stored against the side walls, until the bottles were needed for filling. After the bottles were filled, they were taken down to the third floor, where they passed through the labeling machines and were then packed into cases on the benches in the center of the room. The empty packing cases were unloaded from auto trucks on the street and stored temporarily on the first floor before being taken up to the third floor and placed along the side walls. These boxes were placed on the benches for packing the bottles as needed, and, after the covers had been nailed on, the full cases were piled alongside the benches, ready to be shipped. The water was run into the tanks through pipes, and the ammonia was added, when needed, by a pump. The routing, therefore, was very simple.

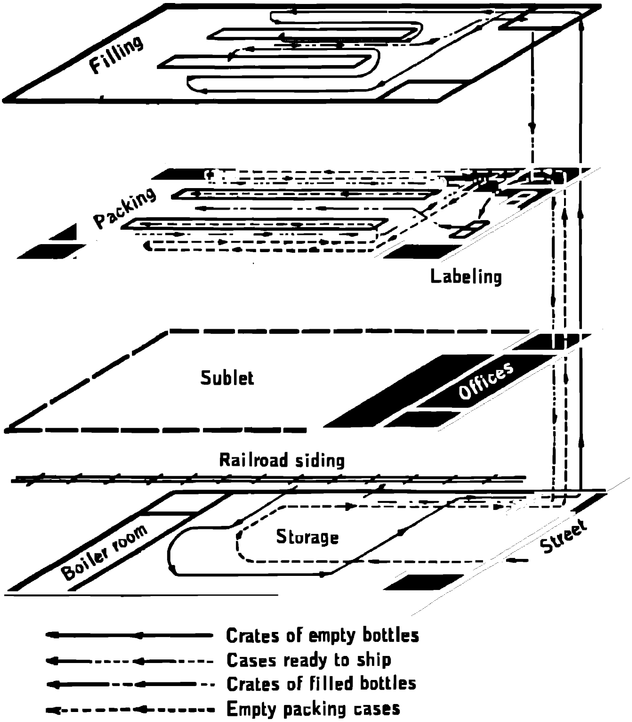


Exhibit 1. Ajax Ammonia Company. Layout of Plant.

Crates of empty bottles (see Exhibit 2) were stacked against the walls in places that were difficult of access, and broken bottles and refuse of all kinds were piled high in front of the window. Two good bottling machines were set in line, end to end, as shown. Ventilation was poor, and men were unable to work on the bottling machines for more than three or four months at a time because of the effect of ammonia fumes on the lungs. The labor turnover was consequently very high. After the bottles were filled and corked, they were taken down the elevator on trucks. Breakage resulting from rough handling was heavy. Two men bottled the liquid, another corked the bottles, while a fourth was used frequently to bring up cases of empty bottles and to sort out the broken glass.

The filled bottles came down from the fourth floor (see Exhibit 3) in crates. They were run through the labeling machines, replaced in the same crates, and set on the floor near the machines. The packers then walked down the aisle between the packing benches, picked out a half-dozen bottles, and walked back to put them in the packing cases. This operation was repeated until all the bottles were packed. Sawdust was then scattered over the bottles, the covers to the cases were nailed on, and the packed goods were moved off the benches. An obsolete set of labeling machines stood near the elevator. Work frequently was congested at the elevator, and the process of manufacture was often delayed because the elevator was being used to bring up empty bottles or packing cases when bottled goods were waiting to be taken down to the next floor for labeling and packing.

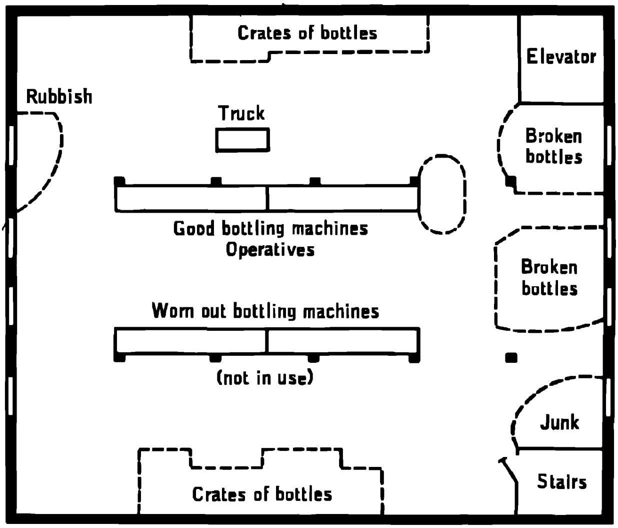


Exhibit 2. Ajax Ammonia Company. Detail of Fourth-floor Layout.

The owner of the Ajax Ammonia Company became convinced that much of the inefficiency of the operation was the result of an incapable foreman. He replaced the foreman with a younger man and told him to "clean up the place and make some sense out of it." Substantial improvement resulted.

Six months later the Comstock Electromatic Corporation offered to buy the land and buildings of the Ajax Company. If this and several other negotiations were successful, Comstock would raze the Ajax building and several other small structures along the railroad spur and replace them with a large modern manufacturing structure. The price offered by the Comstock people was substantially in excess of what the Ajax Company had paid for its property and was thought by the Ajax owner to be more than the property was worth if it were not for Comstock's desire to acquire a large tract along the railroad spur.

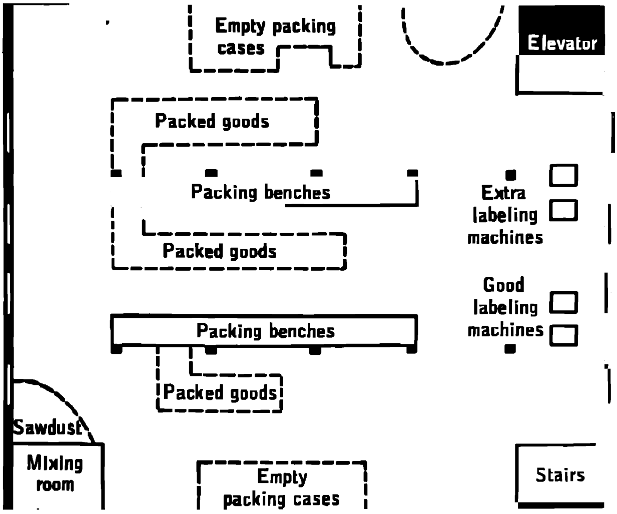


Exhibit 3. Ajax Ammonia Company. Detail of Third-floor Layout.

Before giving the Comstock company a reply to its offer, the owner of the Ajax Company investigated alternative locations for the ammonia manufacturing business. Several miles away on the opposite side of the city he found a new building which he believed might be satisfactory. This building had been completed and was owned by the Pringle Industrial Syndicate. It was not for sale but like other new industrial constructions of the Pringle Syndicate was for lease for a 10-year period with the privilege of lease renewal at a figure to be negotiated at the expiration of the 10-year lease. The annual rental for the first 10 years was no more than the ownership cost of the present building and land.

The new plant was located on a railroad siding and a highway capable of handling motor truck traffic. There was adequate parking space in the rear. The building was a one-story concrete structure, 190 feet long and 76 feet wide. A loading and unloading dock ran the full length of one side of the building. It served the railroad spur which was parallel to it. If desired, some part of this loading platform could be closed in for storage purposes. The truck entrance to the plant was at the rear. There was adequate office space with direct access to a driveway from the highway at the front of the building. The entire floor space was well lighted and ventilated. Additional ventilation by means of power fans would be easy to install. Steam for processing and heating could be purchased at a reasonable figure from a nearby power plant operated by the Pringle Syndicate.

At the request of the Ajax owner the Ajax foreman made a survey of the available Pringle property. He was favorably impressed and reported that he believed the move would be an advantageous one, but that he wanted to sketch a layout for the new plant before finally making up his mind.

QUESTIONS

1. Assume that you are the foreman of the Ajax Ammonia Company. Working from the layouts and flow chart on pages 298, 299, and 300 of the case, prepare:
    - *a.* A flow chart of the process if the business were moved into the new plant.
    - *b.* A layout for the new plant.
2. State any advantages the new plant would have over the old.
3. What disadvantages of the move do you see?

PROBLEM 28 THE N-W MACHINE COMPANY

The N-W Machine Company had experienced a steady growth for many years. As the sales volume increased, the facilities for manufacturing were expanded. At the same time, it had been necessary to add to the supervisory staff and occasionally to establish entirely new functional services. As a part of a careful appraisal of the effects of the com-

pany's long-continued growth, the management was scrutinizing carefully the largest item of cost, manufacturing overhead. It had been suggested that the existing factory layout was responsible in large measure for these high overhead costs.

The N-W Machine Company manufactured machines. The oldest and principal product of the company was a turret lathe, which had been invented in 1892 and which had been the only product of the company from 1892 to 1905. A new design of this lathe and additional sizes of the old design were introduced in 1905. By 1948 an automatic lathe and an automatic die opener had been added to the line. Later a double-spindle turret lathe was developed and put into production. In addition to the manufacture of machines, the company was engaged in repair and special work related to the service of machines that had been installed in the shops of customers.

In all its shops and departments the company had devoted considerable effort to the increase of machine speeds and feeds, to the improvement in methods of doing the work and controlling it, and to other developments of scientific management. The net result of several years' effort was decidedly profitable. The total machining time and total direct labor cost of the product were noticeably reduced and, in addition, the earnings of the workers were increased considerably.

The management next became concerned about the overhead costs. With only a moderate increase in output there had been a noticeable increase in the number of foremen, functional and others, and a great increase in the amount of clerical work that they were called upon to do. The general statistics of the plant showed that the direct labor cost of the product was very small, as had been hoped, that the material cost was much higher, and that the manufacturing overhead was the largest of all. This overhead was so large that, even with a moderate selling expense, profits were small.

The overhead cost had not grown to its present dimensions suddenly or through carelessness. It was the result of slow accretions of small expenses, each added to take care of some real difficulty in management in what appeared at the time to be the simplest and least expensive way. An examination of the various details did not indicate that individual treatment could be improved. It was decided, therefore, that a complete rearrangement of all the elements of the business was necessary so that difficulties in management could be avoided.

One difficulty had arisen because of the arrangement of the shop. The shop was arranged by process. All milling was done in a milling department, all drilling in a drilling department, and all turning in a lathe department. By specializing in a given operation, the foreman and workman became highly skilled in that work and could do it more rapidly than if they were concerned with a wider range of operations. The variation in design of the product made it impossible to arrange the machines in a continuous line. Constant movement of work from department to department, with its consequent slowing up of the work flow, however, had brought division of responsibility, difficulties of control, and increased overhead expenses.

The manufacture of turret lathes, the company's largest income producers, was divided into two classes of work: the manufacture of new machines and a rather large service business in the supply of replacement parts for the machines now in the users' hands. One of the most perplexing difficulties had arisen in the control of the special and repair work related to the service business. Repair orders, both for customers and for the tools, fixtures, and special machines used by the company in production, were irregular and unpredictable. New machines were produced at the rate of 75 per month.

A reorganization was proposed whereby certain products were segregated. Manufacture of these products was to be on a basis of departments by products. Arranging a department by product meant that an individual piece or part would stay in a single department until it was completely finished and ready for assembly. Such a department might be arranged to complete all parts of a similar nature, no matter where found in a machine, or all parts of whatever nature belonging to a given assembly unit of the machine. Both arrangements are to be found in automobile manufacture, where departmentalization by product is the rule.

In the turret lathe shop, it was decided to departmentalize primarily on the basis of the unit assembly, and only secondarily by similarity of parts. This arrangement was expected to prove strongest where the layout by process was weakest. Turret lathes were built in three styles: 2¼-inch, 3-inch, and double-spindle. These machines were designed on the same general plan, and many of the parts of the 2¼-inch and 3-inch sizes were interchangeable, but this was not true to any extent of the latest design, the double-spindle turret lathe.

Major castings entering into the assembly of a turret lathe were headstocks, spindles, beds, turret slides, and turrets. Certain parts for a 2¼-inch lathe, with its higher spindle speed and less powerful drive, were lighter than those for the 3-inch lathe, and specialized manufacturing equipment was necessary to care for this difference in weight.

The space available for the new turret lathe layout was 275 feet long by 100 feet wide (as shown in Exhibit 1), divided by columns

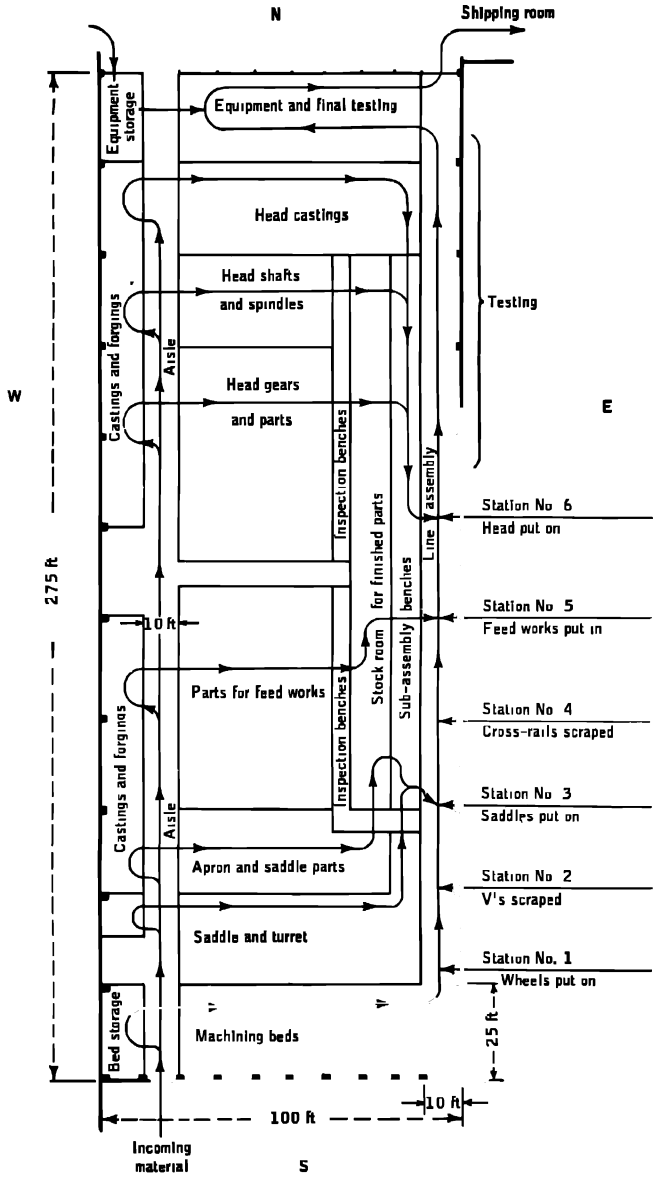


Exhibit 1. The N-W Machine Company. Layout for Turret Lathe Shop.

lengthwise into 10-foot aisles and crosswise into 25-foot bays. The width of shop and width of cross bays had been satisfactory under the previous arrangement. The building was of steel-frame, saw-tooth-roof construction and was fireproof.

Exhibit 1 shows the new arrangement. Incoming material passed north up a long aisle extending the full length of the shop. In the aisle on the left, next to the west wall, were the bins for raw material storage. The center of the shop was occupied by the various manufacturing departments, with the equipment and final testing department at the north end. In successive aisles, toward the east, and running for practically the full length of the manufacturing section, were the inspection benches, storage of finished parts, subassemblies, and line assembly. From the line assembly the finished machines detoured into the bay for equipment and final testing and thence out into the painting and shipping room.

The flow of material was from the southwest corner north to the appropriate department, thence directly east across the width of the shop to final inspection and storage, and thence to subassembly and line assembly. The line assembly moved north on the eastern side and out at the northeast.

Castings for the bed were stored at the west of the aisle. They were taken first to an Ingersoll mill, where the pads on the bottom were milled off, after which the bed was turned over and the crossrails were milled. The bed then went to the roughing planer, then to the horizontal boring and milling machine, and then to the radial drill. After drilling, the bed went to the finishing planer for removal of the "wind" so that the hand-scraper's job could be one of finishing the surface rather than of removing material. The bed was then mounted on wheels instead of on its regular legs, and was ready to start up the assembly line. The bed machining department was under the supervision of the foreman of the line assembly.

Certain departments and operations could not be included in the rearranged layout. The following processes remained departmentalized: steel storage and cutting off; casting, snagging, cleaning, and filling; painting, boxing, and shipping; automatic screw machining; hardening and heat-treating. This last process caused the main break in the orderly flow of work through the shop.

Be prepared to discuss the desirability of the proposed layout.

PROBLEM 29 PIKE MANUFACTURING COMPANY

The Pike Manufacturing Company of Austin, South Carolina, was awaiting the delivery of 59 new machines for use in the company's cloth room. The new equipment, when installed, would eliminate all table inspection of cloth as well as the operations supplementary to table inspection. In line with the use of new equipment, the production engineering department was assigned the task of preparing a new floor layout for the cloth room.

The Pike Manufacturing Company produced cotton, rayon, and nylon cloth at the rate of approximately two million yards per week. The cotton and nylon cloth were used for lightweight drapery material, while the rayons were used for suit linings. The company employed approximately two thousand workers on a two-shift basis and was producing cloth at full capacity.

In the production of the cotton cloth, raw cotton was cleaned, opened, and spun into yarn. The yarn was woven into cloth and then sent to the cloth room for shearing and inspection.[1] The cloth was then shipped to outside finishing plants where it was dyed and printed and otherwise prepared for sale to manufacturers. The rayon and nylon yarns were purchased from outside suppliers and woven into cloth in the company's plant. After weaving, the rayon cloth was sent to the cloth room for inspection and shipment.

The company's cloth room was set up to handle about 900,000 yards of rayon cloth and 1,000,000 yards of cotton cloth per week.[2] On each of two shifts there were 140 production employees in the cloth room, both men and women, and about six nonproduction workers.

Exhibit 1 is a list of the steps of the cloth-room process for cotton cloth. Exhibit 2 is a list of the steps of the cloth-room process for rayon cloth. Exhibit 3 shows the floor layout of the cloth room as it existed prior to the installation of new equipment.

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[1] The cloth was transported from the weave rooms to the cloth room on electric trucks. There were several weave rooms. Some of them were adjacent to the cloth room and some were not. One was almost a city block away.

[2] The amount of nylon handled in the cloth room was relatively small. If 10 of the rayon-inspection machines were kept available for nylon inspection, this material could be disregarded in arranging the cloth room.

Under the existing layout, cotton cloth coming in from the south end of the cloth room was weighed and stored near the sewing machines. Here the small rolls of cloth were sewed together and made into large rolls suitable for the shearing machines. In the shearing operation raised patterns were made on the cloth by knives that cut and ruffled the heavy extra yarn woven across the cloth. Following the clipping operation, the large rolls of cloth were sent to the folding machines where they were unrolled and folded preparatory to table inspection. The inspector examined each fold of cloth and held it up to the light, looking for surface misweaves and then graded the cloth as to first or second quality. After inspection, the cloth was stored by style and factory order number in racks near the inspection tables. After a complete factory order was assembled in the racks, the cloth was delivered to the hydraulic presses for baling and then was transported to the storage building prior to shipment to finishing plants.

Exhibit 1 Pike Manufacturing Company

Process Analysis—Cotton Cloth

1. Cloth delivered from weave rooms
2. Cloth stored on trucks near scale
3. Cloth moved to scale
4. Cloth weighed
5. Cloth moved to rear of sewing machines
6. Cloth unloaded from trucks
7. Cloth stored in rear of sewing machines
8. Cloth sewed and rolled
9. Cloth stored in front of sewing machines
10. Cloth moved to shearers
11. Cloth sheared
12. Cloth moved to rear of folders
13. Cloth stored on floor
14. Cloth placed on folders
15. Cloth folded and seams cut by hand
16. Cloth stored in front of folders
17. Cloth moved near inspection table
18. Cloth stored near inspection table
19. Cloth moved to inspection table
20. Cloth inspected, graded visually
21. Cloth placed in rack according to order number
22. Cloth stored until sufficient for bales accumulates
23. Cloth loaded on trucks
24. Cloth moved to scale
25. Cloth weighed
26. Cloth moved near presses (balers)
27. Cloth stored
28. Cloth moved to presses
29. Cloth in burlap with wire
30. Bale stenciled
31. Bale pushed off press
32. Bale seams sewed by hand
33. Bale moved on pallet
34. Bale stored on pallet
35. Pallets picked up by fork truck, moved to shipping, storage buildings
36. Bales stored on pallets
37. Bales moved to ramp and placed in delivery truck

(The storage building was about a city block from the cloth room, and the cloth was taken there on electric trucks.)

Since the rayon cloth was not sheared, it was weighed and immediately folded on machines. This cloth was then singed to remove loose ends and moved on for inspection. Rayon cloth was table-inspected in a manner similar to cotton cloth and, after being graded, was stored in racks near the rayon-inspection table ready for baling and shipping. There were 10 rayon-inspection machines on the cloth-room floor, but these were used for nylon-cloth inspection.[3]

Exhibit 2 Pike Manufacturing Company

Process Analysis—Rayon Cloth

1. Cloth delivered from weave rooms
2. Cloth stored near scale
3. Cloth moved to scale
4. Cloth weighed
5. Cloth moved to platform in front of folders
6. Cloth stored
7. Cloth placed in folding machine tray
8. Cloth folded
9. Cloth stored near rayon-folding machines
10. Cloth moved in trucks to singeing area
11. Cloth singed
12. Cloth moved to rear of inspection table
13. Cloth placed on storage platform
14. Cloth stored
15. Cloth moved to inspection table
16. Cloth inspected and graded visually
17. Cloth moved to trucks near inspection table
18. Cloth stored until truck is filled
19. Cloth moved to storage racks
20. Cloth placed on racks according to order number
21. Cloth stored until sufficient for bale or case
22. Cloth placed on truck
23. Cloth moved to scale
24. Cloth weighed
25. Cloth moved to pressing or casing area
26. Cloth stored
27. Cloth baled or cased
28. Bale pushed off press
29. Bale seams sewed by hand
30. Bale moved to pallets
31. Bales stored on pallets
32. Pallets picked up by fork truck, moved to shipping, storage buildings
33. Bales stored on pallets
34. Bales moved to ramp and placed on delivery truck

All machines, except the shearers, were powered by individual motor drive. The cotton shearers were large, heavy, special-purpose machines belt-driven from line shafts. There was a line shaft for each of two rows of clippers, the two line shafts being driven by one motor.

The new machines on order included 36 cotton-inspection machines, 20 rayon-inspection machines, two rayon trimmers, and three rayon sewing and rolling machines. Exhibits 4*A* and 4*B* are drawings of the

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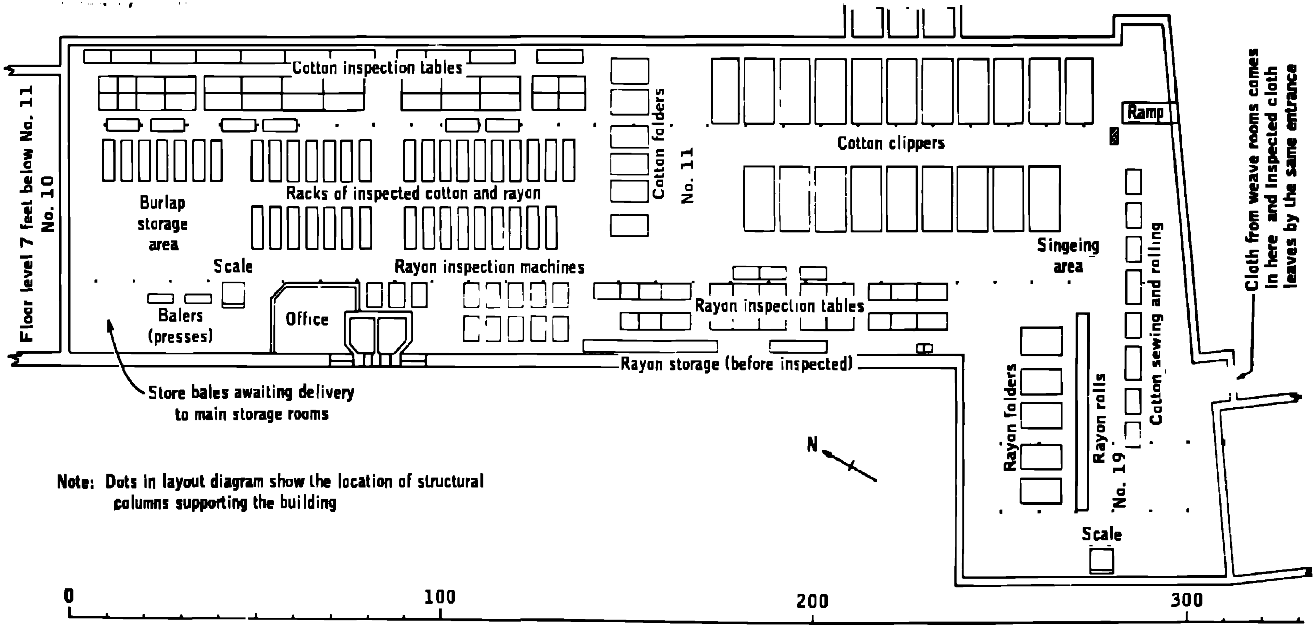
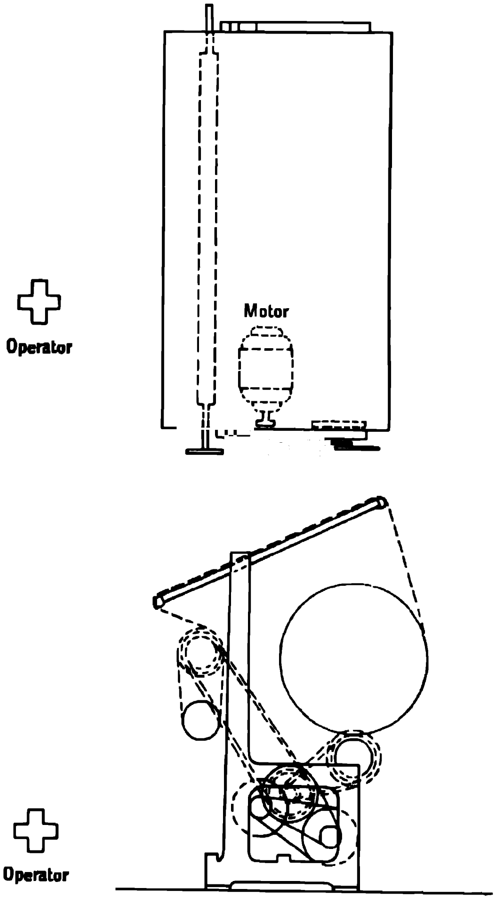
[3] In any reorganization of the cloth-room floor these machines had to be kept available for nylon inspection.


Cotton inspection tables
Floor level 7 feet below No. 11
No. 10
Burlap storage area
Racks of inspected cotton and rayon
Scale
Rayon inspection machines
Balers (presses)
Office
Store bales awaiting delivery to main storage rooms
Cotton folders
No. 11
Rayon inspection tables
Rayon storage (before inspected)
Cotton clippers
Singeing area
Ramp
Cotton sewing and rolling
Rayon folders
Rayon rolls
No. 19
Scale
N
Cloth from weave rooms comes in here and inspected cloth leaves by the same entrance
0
100
200
300

Note: Dots in layout diagram show the location of structural columns supporting the building

Exhibit 3. Pike Manufacturing Company. Cloth Room Layout.

cotton- and rayon-inspection machines on order. These machines were designed to eliminate table inspection. Rolls of cloth would be placed at the back of the machine, the cloth brought forward over the machine table, and rerolled. The inspectors would examine the cloth as it unwound and passed over the machine table. The rayon rolling and sewing machines would perform the same functions as the present cotton rollers and sewers, namely, to sew ends of small rolls of cloth to yield larger rolls. The rayon trimmers would trim the ends of the cloth and remove loose threads, thereby eliminating the singeing operation.



Floor space required 6' x 3'

Exhibit 4A. Pike Manufacturing Company. New Rayon-Inspection Machine.

The three rayon rollers and sewers and the two rayon trimmers would require the same square footage of floor space as the five rayon folders then in use.

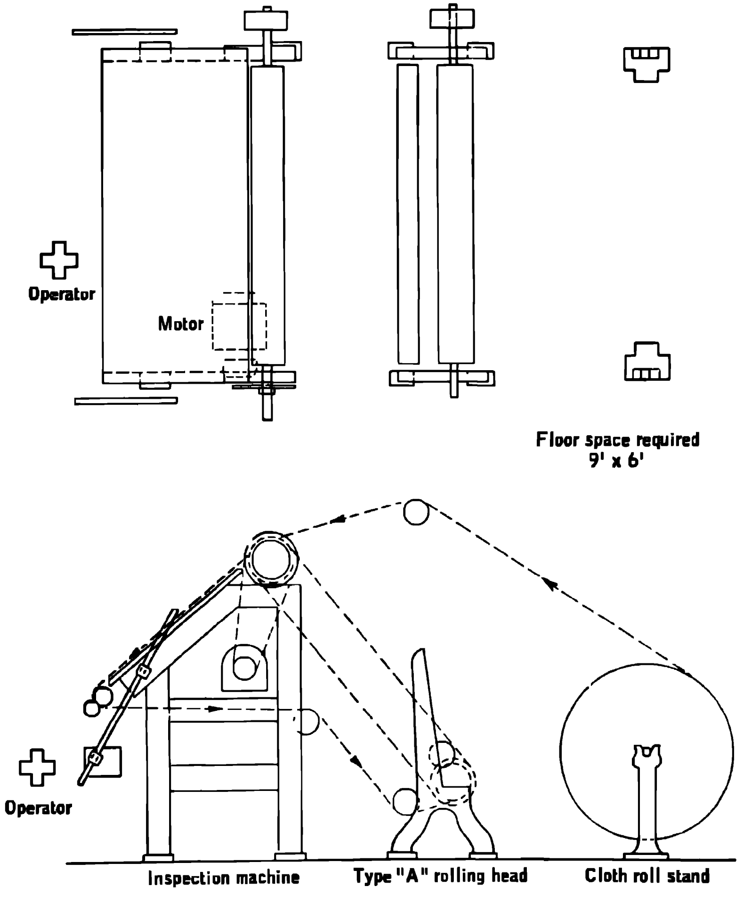
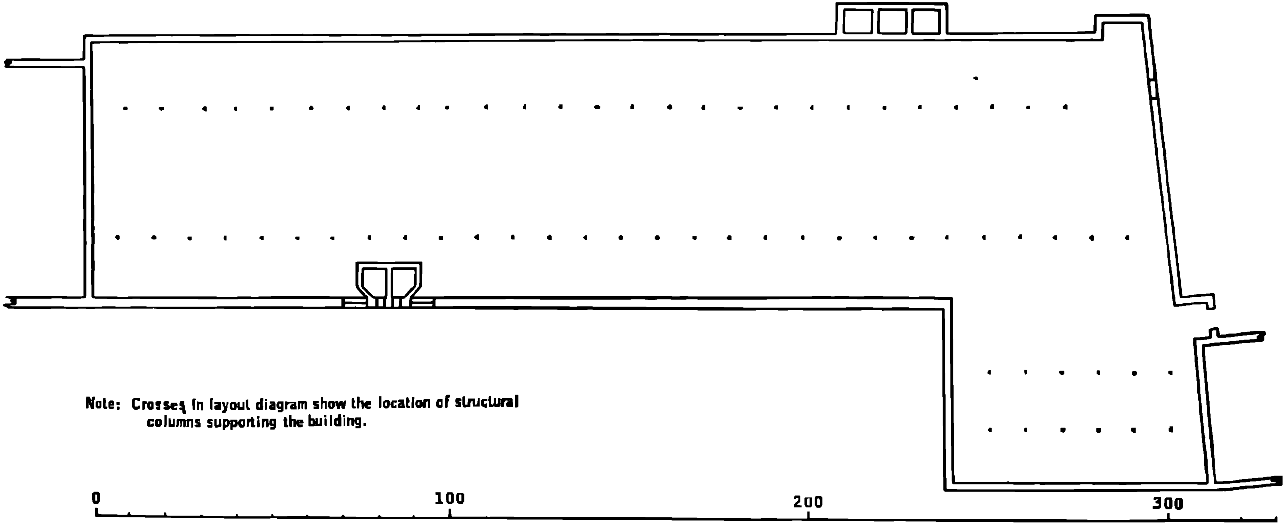


Exhibit 4B. Pike Manufacturing Company. New Cotton-Inspection Machine.

At the time the production engineering department was preparing the new floor layout, an adjoining room (10 at the north end of the Exhibit 3 diagram) was being vacated. The company officials had not definitely decided upon the future use of this room, but the production engineer believed that it should be used for storage of cloth from the cloth room and planned the rearrangement of the cloth room with that in view.



Note: Crosses in layout diagram show the location of structural columns supporting the building.

Exhibit 5. Pike Manufacturing Company.

Using the diagram, Exhibit 5, page 312, prepare a layout for the rearrangement of the cloth room utilizing the new equipment. The four rows of crosses in this diagram represent steel columns which cannot be moved when rearranging the equipment.

PROBLEM 30 UNITED STATES SHIRT COMPANY

The United States Shirt Company was one of the largest manufacturers of men's shirts, sports jackets, and nightwear in this country. The most important item made was men's dress shirts, which were produced at the rate of 1,400,000 dozen a year. These together with sport shirts, pajamas, and jackets required the purchase of 42,000,000 yards of piece goods and large amounts of lesser items such as buttons, of which 800,000 gross were used.

The company had four sales subsidiaries. One sold nationally advertised, popular-priced shirts to retailers. The company's high-priced line, sold through another subsidiary, also was nationally advertised. A third sales subsidiary sold a line of branded shirts priced between its popular-priced and high-priced lines. Over one-half of the company's output was sold by the company's fourth subsidiary, the Franklin Company. Its customers included the jobbing trade, large and small chain store organizations, large mail order houses, and a relatively small number of foreign accounts. None of this subsidiary's business was in high-priced items.

From the production point of view the company manufactured a most varied output of dress shirts: scores of fabrics and fabric patterns; one to two dozen collar styles; varied pocket and cuff styles; ten sizes, each in three sleeve lengths. The combination of these variations resulted in the production of over 40,000 different completed items a year. Fashion changes occurred from year to year as company designers strove to attract customers to new style cuts, fabric colors and designs, and types of fabrics. To a large extent customer tastes were difficult to forecast. An item that was little sold in one season might be in great demand the next, only almost to disappear from the line the following year. Demand varied seasonally, with three yearly peaks at Christmas, Father's Day, and Easter. The load on production facilities also was influenced by the differences in delivery lead time required by retailers, wholesalers, chains, and catalogue houses.

The company operated 23 sewing plants, eight of which made dress shirts only. These eight plants varied in size. The smallest employed 120 operators and had a capacity of 1,200 dozen shirts a week. The largest could turn out 6,500 dozen shirts weekly and employed 550 operators. Work was allotted to these plants by the company's planning section in the New York sales office.

Typically a dress shirt was an assembly of approximately 25 cloth parts. Exhibit 1 shows some of the principal parts and subassemblies.

Common operations required in the sewing of a shirt include the following:

- Center side making
  - Center running
  - Center hemming
  - Buttonhole making
  - Pocket setting
  - Trimming
  - Examining
- Pocket making
  - Top folding
  - Top stitching
  - Sides folding
- Button side making
  - Button side running
  - Hemming
  - Button sewing
  - Trimming
  - Examining
- Back making
  - Back hemming
  - Gusset sewing
  - Sewing label to yoke
  - Sewing yoke to back
- Band making
  - Bottom band ply, top band ply, collar and lining sewing
  - Band turning
  - Band stitching
  - Band notching
  - Buttonhole making
  - Button sewing
- Collar making
  - Two ply and lining sewing
  - Point trimming
  - Collar turning
- Sleeve making
  - Sleeve piecing
  - Under facing
  - Top facing
  - Sleeve blocking
- Cuff making
  - One ply and lining sewing
  - Second ply seaming
  - Cuff turning
  - Buttonhole making
  - Button sewing
- Joining
  - Back, center, and button side joining
  - Collar setting
  - Collar closing
  - Sleeves (two) setting
  - Felling
  - Cuffs (two) setting
  - Cuffs (two) closing
  - Trimming
  - Examining

The operations involved in stitching a shirt were organized to perform the sewing process in three different ways. In the company's two small plants a "bundle system" was in use. In this process organization work was divided so that an operator performed only one of the operations in the foregoing list. The unit of work was a bundle of cut or partially sewn parts. Bundles of parts were carried to the operators from inventory or from a preceding operation by "bundle boys." Exhibit 2 on page 316 shows this process organization.

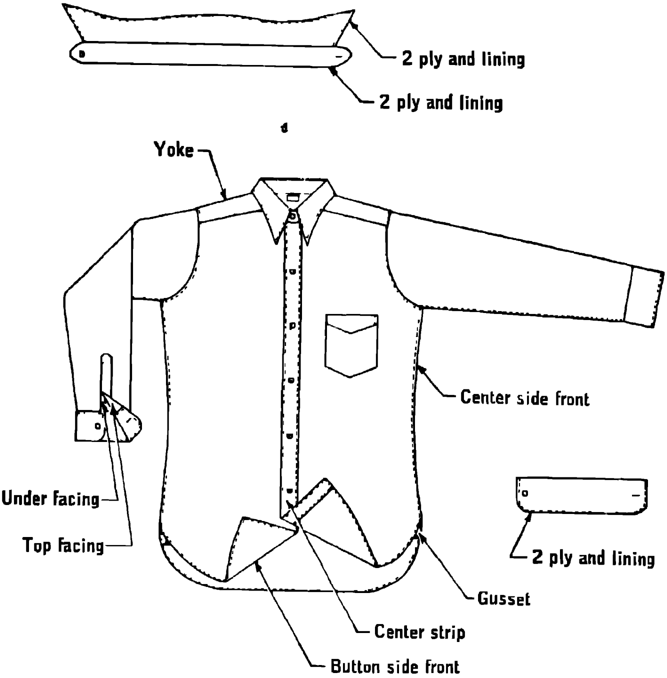


Exhibit 1. United States Shirt Company. Principal Parts and Subassemblies Making up a Man's Dress Shirt.

In the two largest company plants the process was organized on a "line" basis. Each worker performed a single operation. Exhibit 3 on page 317 shows the process organization in the two largest plants.

The other plants were organized on the "unit" basis. Worker specialization in these plants was similar to that in the smallest and largest plants. Exhibit 4 on page 318 shows this type of process organization.

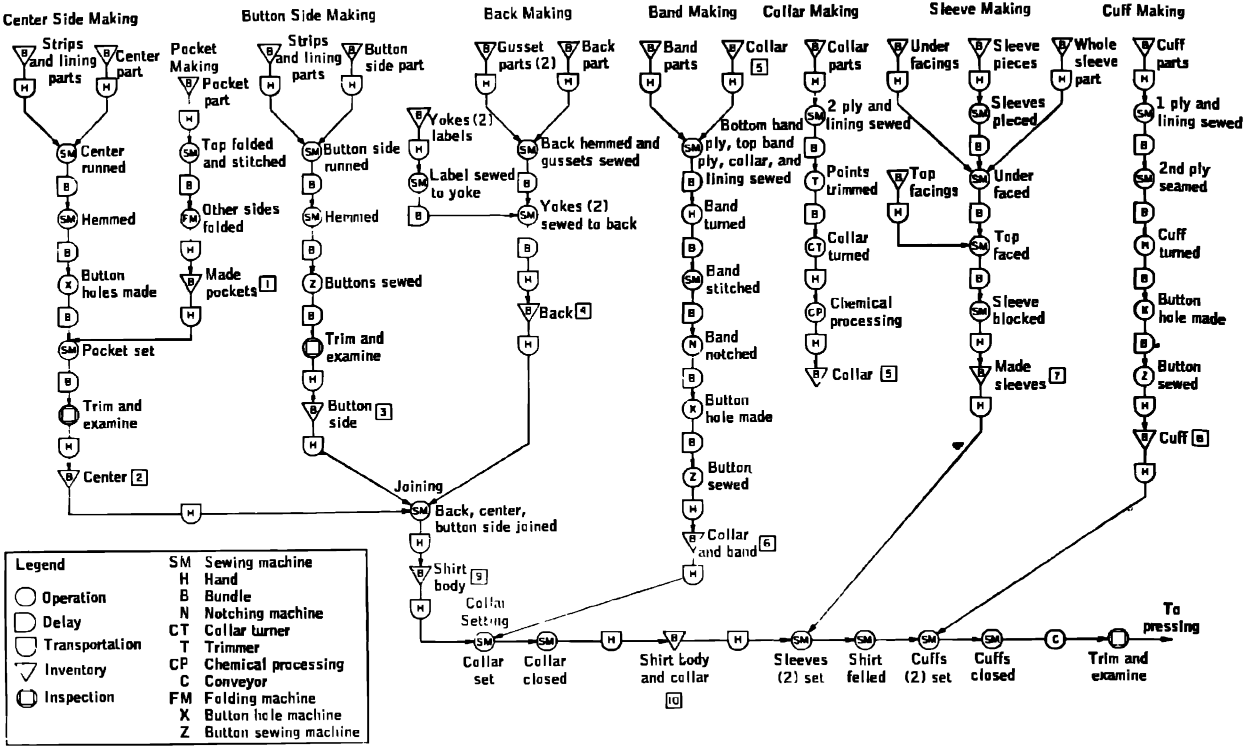


Exhibit 2. United States Shirt Company. Bundle System of Process Organization.

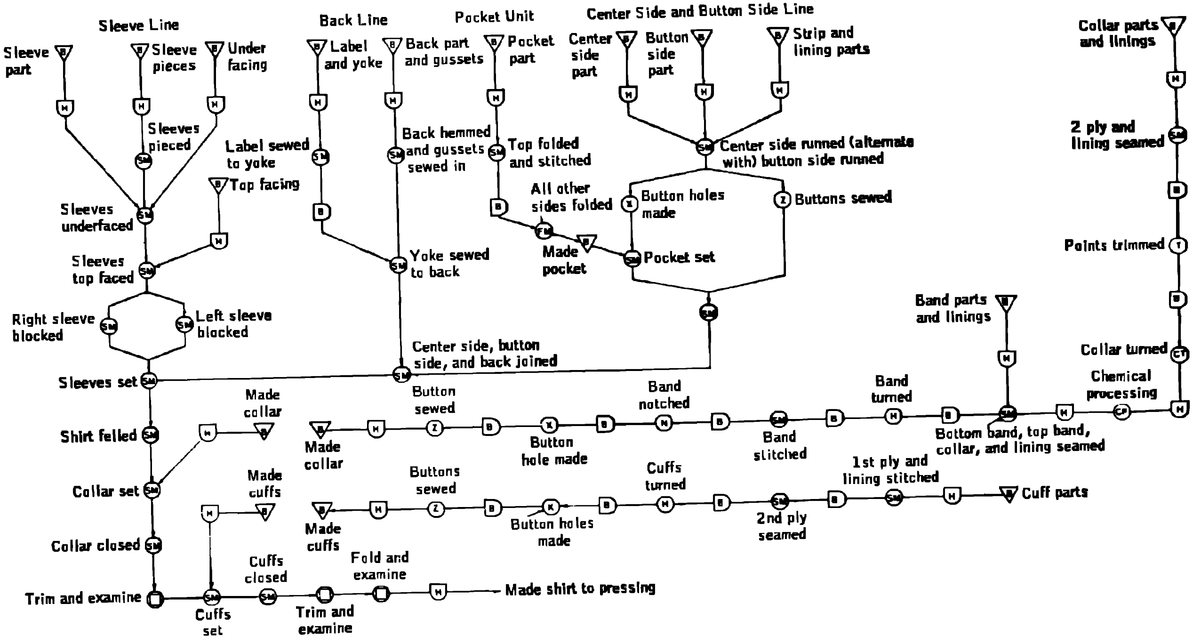


Exhibit 3. United States Shirt Company. Line System of Process Organization.

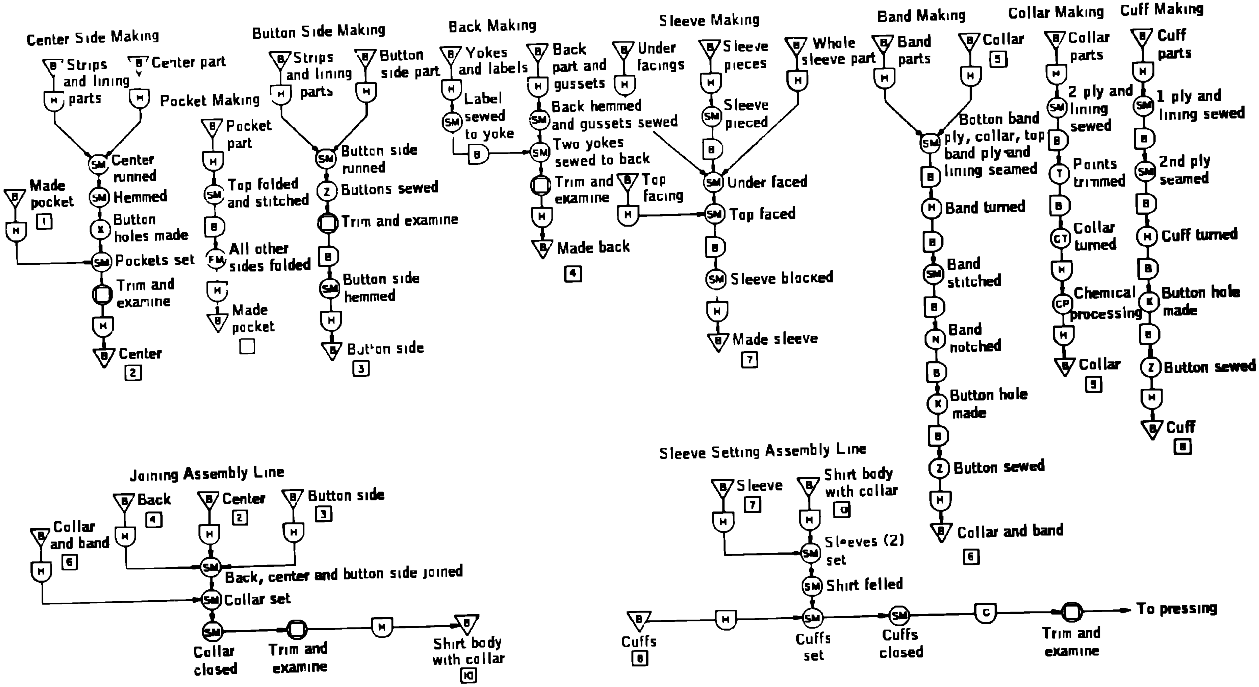


Exhibit 4 United States Shirt Company Unit System of Process Organization.

QUESTIONS

1. Analyze the three types of process organization—bundle, line, unit—to determine the differences between them. Detailed study of the diagrams will reveal many points of similarity and differences. Comparisons such as the following will be found useful in analyzing these three systems:
   a. Number of operations
   b. Number of times parts and work in process are tied up in bundles
   c. Number of temporary delays
   d. Number of transports of parts and work in process made by bundle boys
   e. Number of times work in process is moved into inventory
   f. Number of independent production sections
2. The layouts of the company's plants varied with the type of process organization. Describe the layout requirements for each process type.
3. Why should this company have three different types of process organization and plant layout?
4. In allotting work to plants should the central planning department in New York consider the differences in plant layout? Explain.

12

POWER

FOSTER YARN, INC.

1. CHANGES IN POWER APPLICATION HELP A COMPANY TO MEET CHANGING BUSINESS CONDITIONS

Foster Yarn, Inc., manufacturer of worsted yarns used for knitting purposes, was experiencing difficulty in maintaining its earning position. Much was done to reduce costs of operation. Among the items of operating expense scrutinized was the cost of power, which the company always had generated. Changes made in supply and application of power brought about substantial economies. Essentially, these changes involved doing away with central steam-engine drives and installing a well-considered combination of individual and group motor drives.

2. MANAGEMENT'S RELATION TO THE POWER PROBLEM

Every factory management faces the problem of providing power for the operation of machinery. The generation, transmission, and application of power have been continuously developed until today they may constitute technical problems of great intricacy. In the large plant which uses much power a staff of specialized experts is employed to take care of power problems. In the small plant such a specialized technical staff is too costly, and all too frequently the power situation is not given the attention it deserves.

The employment of power technicians does not relieve management of responsibility for considering power problems. The power engineer knows the technique of producing power and applying it to machines and equipment. Usually he can translate these technical considerations into dollars. Often he can make suggestions to the management as to action to be taken in terms of his technical knowledge and cost findings. Such advice is of great value to management and should be regarded and used just as management uses the work of experts in the more familiar fields of accounting, statistics, and product design. Management should not expect the power engineer to have complete grasp of the business implications of power problems. Thus, management should assume the same attitude toward power specialists that has long been held in relations with other specialized technicians. The final decisions on power problems must be made by management. Executives cannot escape this responsibility. They are often better equipped to weigh and judge the short-range and long-range business implications in power supply and application than is the technician who is specialized in the field.

3. PURPOSE OF THIS CHAPTER

The experience of Foster Yarn, Inc., is included in this text because it is an excellent illustration of the point that the selection of power equipment and its installation has business aspects that call for managerial consideration. No attempt will be made in this chapter to discuss such typical power problems as choice between produced and purchased power, or choice of fuels when a manufacturing company generates its own power. The discussion will attempt to establish two points only, namely, that many power problems are business problems and that as such they are the concern of management.

4. FOSTER YARN, INC.

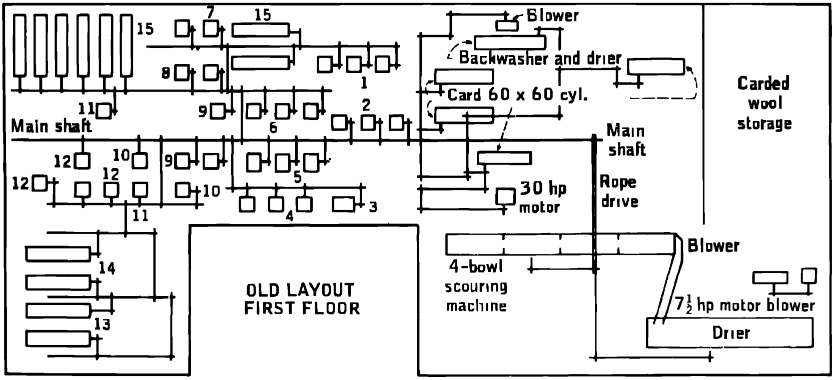
As the result of reorganization of an older firm, Foster Yarn, Inc., of Trenton, New Jersey, was incorporated with a capitalization of $100,000. The company made a variety of worsted knitting yarns and twists from 10-count to 30-count. The company also bought 300-denier rayon yarn, which it used in combination with yarns made from wool. The products were marketed direct to retailers. The company had 100 employees.

5. PLANT LAYOUT AND POWER APPLICATION

Steam to supply the company's heat, process, and power needs was generated at 115 pounds in an old boiler which was rapidly decreasing in efficiency. Power was supplied by a Corliss engine through a main drive shaft and take-off belts. A complicated and inefficient rope drive ran from the main drive shaft on the first floor to the scouring department, and belts led to main shafts on the second floor, from which there also were take-off belts. Layout of equipment, together with shaft and belt drives, is shown for the first and second floors in Exhibits 1 and 3 on pages 322 and 324.

6. OBJECTIONS TO THE OLD POWER SITUATION

Power-transmission maintenance costs were high. Shaft bearings were not antifriction and therefore had to be lubricated at least once a week. The 3½-inch, 2-ply leather belts required frequent adjustment, and, in spite of every effort for proper maintenance, slippage occurred.



Key:
1. Three single-head gill boxes, after backwasher.
2. Three single-head gill boxes, second process.
3. One punch box.
4. Three Noble combs, double dobber motion.
5. Three single-head gill boxes, first process after combing.
6. Three single-head open gill boxes, second process after combing.
7. Two double-head open gill boxes, third process after combing.
8. Two double-head open gill boxes, fourth process after combing.
9. Three 2-spindle open gill boxes, first process in drawing.
10. Two 4-spindle drawing boxes, second process in drawing.
11. Two 6-spindle drawing boxes, third process in drawing.
12. Four 10-spindle drawing boxes, fourth process in drawing.
13. Two 24-spindle reducers, fifth process in drawing.
14. Two 36-spindle reducers, sixth process in drawing
15. Six 36-spindle finishers and two 100-spindle finishers.

Exhibit 1. Foster Yarn, Inc.

On damp days it was not uncommon to find variations of 15 to 20 revolutions per minute, which at the spindles resulted in discrepancies of 150 to 200 revolutions per minute. Variation in spindle speed was a serious matter, since uniform speeds were essential to high quality of output. A soft yarn called for a certain spindle speed, while a hard yarn needed an equally definite though higher speed. Regulation of machine speeds was a matter constantly requiring the attention of foremen.

Whenever a change was made in the type of yarn being spun, a troublesome alteration in speed of drives was necessary. If a spinning frame had been running on 2-ply 20-count yarn and a change to 2-ply 16-count yarn was required, it was necessary to shut down all machines on the floor for a half hour while two maintenance men climbed up ladders, removed a heavy split pulley about 38 inches in diameter, and put on another that was equally heavy and hard to handle. With the exception of the particular frame whose speed was to be changed, the floor could then resume operation. On the one frame, however, change in pulley size necessitated change in the length of the 62-foot belt which connected the frame to the main shaft. Adjustment of this belt often took as much as an hour. Under these conditions seven or eight doffs[1] were considered a good day's output.

7. EFFECTS OF RECESSION ON ORDER SIZE AND FREQUENCY

One effect of slackened business conditions throughout the industry was a decrease in the average size of orders and an increase in the number of orders. It had become common for customers who formerly had ordered in 500-pound lots to reduce purchases to 50-pound lots. Decrease in total volume of orders and shrinkage in order size were critical problems for executives of Foster Yarn, Inc.

8. CHANGES IN POWER SUPPLY AND APPLICATION

Remedy for profit shrinkage was sought through reduction of production costs, and intensive consideration was given to all elements of expense. As a result of the study of power cost, the supply and application of power were changed completely at a cost of approximately $8,000. The first change was to stop producing power in favor of purchasing it from an outside producer. The steam-boiler equipment, although obsolete for power purposes, was still used effectively for supplying steam for processing and heating. The line-shaft drive layouts, shown in Exhibits 1 and 3, were scrapped, and in their places carefully considered combinations of group and individual motor drives were installed. Group drive was employed where the types of machinery were such that a number of machines could be operated economically as a group. In Exhibit 2, which shows the new first-floor layout, it will be noted that one 25-horsepower motor drives as a group the scourer, the drier, and the blower that conveys the wool from the scourer to the drier. The scourer and the drier were always operated at the same time, the one operation immediately following the other with the blower conveyor acting as the connecting link. This arrangement was much more economical than the complicated rope drive from the main shaft shown in Exhibit 1. As the individual machines making up this group were never operated singly, little would have been gained by equipping each machine with a motor of its own.

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[1] A doff is a complete replacement of full spindles on a frame with empty spindles and necessitates adjustment of spindle speeds only when a change in type or size of yarn is made.

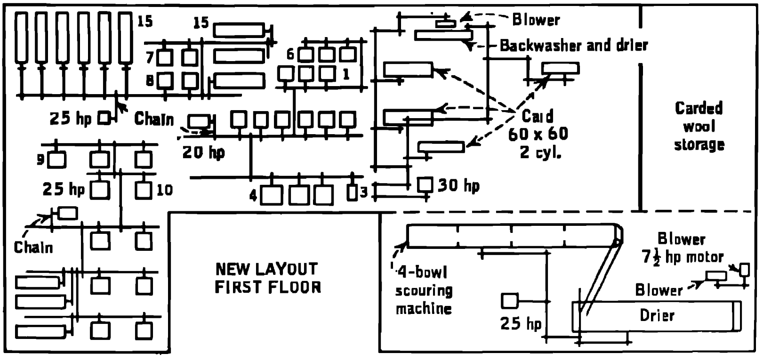
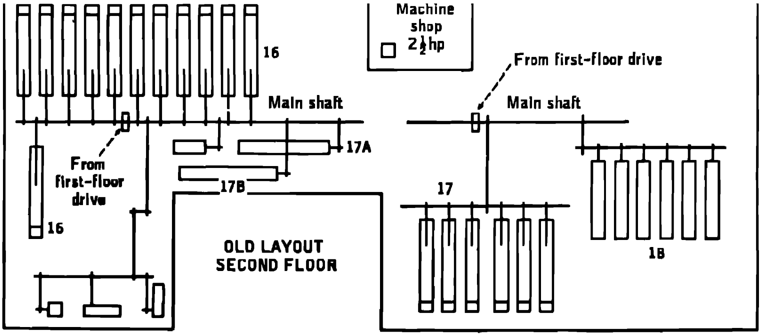


Exhibit 2. Foster Yarn, Inc. The numbers in the key to Exhibit 1 apply to Exhibit 2 except in the case of some of the regroupings of machines.

The equipment in the carding and drawing room suggested the arrangement into four groups, shown in Exhibit 2. A 30-horsepower motor drove the four cards and the backwasher. A 20-horsepower motor was used to operate 3 combs, 12 gill boxes, and the punch box.

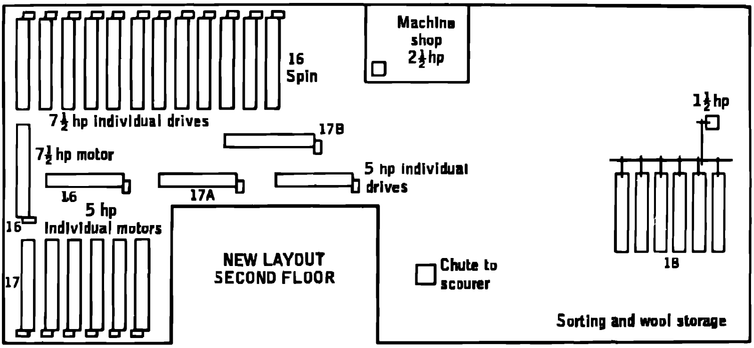


Key:
16. Twelve 168-spindle cap spinning frames, 3½-inch gauge.
17. Six 160-spindle cap twister frames, 3½-inch gauge.
17A. One 160-spindle cap twister frame, 3½-inch gauge.
17B. One 146-spindle cap twister frame, 4½-inch gauge.
18. Six 50-spool skein reels.

Exhibit 3. Foster Yarn, Inc.

The drawing frames were segregated into two groups, each driven by a 25-horsepower motor.

Most of the second-floor equipment was individually motored, as shown in Exhibit 4. In the new layout there were 14 spinning frames, each of which was equipped with a 7½-horsepower motor. A sample frame had a 5-horsepower motor, and individual 5-horsepower motors drove the twisters. The six 50-spool skein reels were driven as a group, one 1½-horsepower motor being adequate for their operation.



Key:
16. Twelve 168-spindle cap spinning frames, 3½-inch gauge.
17. Six 160-spindle cap twister frames, 3½-inch gauge.
17A. One 160-spindle cap twiste frame, 3½-inch gauge.
17B. One 146-spindle cap twister frame, 4½-inch gauge.
18. Six 50-spool skein reels.

Exhibit 4. Foster Yarn, Inc.

In all cases, group line shafts were chain-driven rather than belt-driven. Motors were equipped with antifriction bearings. Those on the second floor were packed with waste that needed only three oilings a year. First-floor motors were controlled through manually operated compensators. The spinning frames had reduced-voltage primary-resistor control, and full-voltage push-button control was used on the twisters.

9. RESULTS OF THE CHANGES

Change of speed on the twisters and spinning frames could be accomplished in a few minutes. It involved loosening the motor on its base, sliding the motor forward to release the multiple V-type drive belt, knocking the pulley from the tapered shaft of the motor, slipping on a new pulley of the proper size, replacing the drive belt, sliding back the motor to the point of proper belt tension, and tightening four bolts to hold the motor in proper position. Five to ten minutes was the time required.

The new layouts shown in Exhibit 2 and Exhibit 4 involved a total connected load of about 275 horsepower. With it 9 or 10 doffs per day were obtained. An annual power saving of $2,600 was effected, which, together with other savings, caused the vice-president of Foster Yarn, Inc., to make the statement, "We should not be in business today if we had not made the change."

10. SUMMARY AND CONCLUSIONS

It was not the power saving of $2,600 a year that enabled Foster Yarn, Inc., to stay in business. Far more important was the ability of the company to meet the changed demands made upon it. A period of business uncertainty affected the demand for yarns such as this company made. With the slackening in consumption came another change, namely, orders were smaller. Buyers were hesitant to stock yarns heavily and ordered in small amounts, reordering in small lots whenever demand seemed to justify it. Thus a manufacturer, to retain his share of the total demand, found it necessary to cater to market request for quick shipment of small orders. Price and quality were also of great importance for the manufacturer who was to retain his competitive status during the recession. Executives of Foster Yarn, Inc., were faced with the necessity of producing a high-quality product at low cost in such a way as to be able to make small shipments quickly and frequently.

How the New Methods of Applying Power Were Superior to the Old. The methods of applying power that had been in use were not well suited to the new requirements. It took a relatively long time to change speeds at the spindles when a different yarn construction was required. With the trend to small, frequent orders, these changes had to be made more often. Also it was necessary to shut down a large number of machines in order to make a change on one of them. This characteristic tended to waste both machine time and direct labor time.

By installing individual motor drives on each unit that required separate changes, it was possible to shut down one machine alone, and the cost of idle machines and men was nearly eliminated. The method of driving each machine also made it possible to change spindle speeds quickly and at little cost. In this way the characteristically high cost of producing in small lots to fill request orders was kept at a minimum, and the company placed itself in an advantageous position to cater to the new market requirements of quick delivery of small orders at low cost.

The use of individual motors connected to the spinning frames by multiple V-type belts improved the quality of the yarn by making it more uniform. The old driving method resulted in slippage, causing variation in spindle speeds of as much as 200 revolutions per minute. Much of the foremen's time was spent in attempting to keep equipment operating at proper speeds. In spite of all efforts, speeds had varied greatly. The new driving method eliminated this slippage. The foremen were thus relieved from constant watching for variation, and the product was much improved. This improvement in quality was of great importance to the company and, coupled with ability to deliver small orders quickly at low cost, explains in major part the ability of the company to meet the increasingly keen competition.

The equipment changes produced other economies. Maintenance costs were reduced. Less power was used, and power savings resulted.

Individual Motor Drive versus Group Drive. Obtaining the flexibility of individual motor drive is likely to be more costly in some respects than the use of one larger motor to drive several machines. The total horsepower of the several individual motors is usually greater than the horsepower of a single motor adequate to drive the same number of machines. This tends to increase both the cost of power equipment and the cost of power. Power rates charged by a central generating plant are determined in part by the total connected horsepower load of the customer. The utility company must be prepared to furnish power to meet the maximum connected load, and, therefore, the greater the aggregate horsepower of the motors operated by a manufacturer, the greater tends to be that part of the rate which is based on total connected load.

The purchase price of motors per horsepower tends to be greater for small motors than for large. Also individual motor drives require more control devices and wiring, with their attendant costs. Maintenance costs tend to be greater per horsepower for a number of smaller motors with their starting equipment than for a single larger motor. It should also be mentioned that small motors are characteristically less efficient in the use of electricity than large motors.

It is obvious that from a business standpoint the use of individual motor drives as compared with group drives may well constitute a serious problem. The individual motor drive provides flexibility. When flexibility is needed, it will be well worth the greater installation and operation costs. When flexibility is not needed, group drive may well be superior in that its costs tend to be lower. The new layout of Foster Yarn, Inc., recognizes this situation and seems to meet it intelligently.

Situations of this sort are business situations and call for the thoughtful consideration of business executives. The need of flexibility to meet changing market conditions faced by Foster Yarn, Inc., is an excellent illustration of this. The executive need not be a power expert to discharge adequately his responsibility in this area. Technical services can always be purchased, and it is the function of the business executive to seek such service when it is needed and use it in a business way in the interest of profits.

QUESTIONS

1. What were the major problems faced by the management of Foster Yarn, Inc.?
2. Why did the change in market conditions present a plant problem?
3. In what other respects was the old power installation unsatisfactory?
4. What was done to remedy these unsatisfactory conditions?
5. What were the advantages of the new type of power application?
6. Were there any disadvantages? If so, what were they?
7. What would you expect to be the long-run effects of the power changes?
8. If the cost of the changes was $8,000 and the annual power saving therefrom was $2,600, how can it be argued that the change was economical?
9. Was the power problem of Foster Yarn, Inc., intelligently solved as a business problem? Explain.
10. Why is it not wise for a business executive to place the entire control of the plant power problem in the hands of the power engineer?

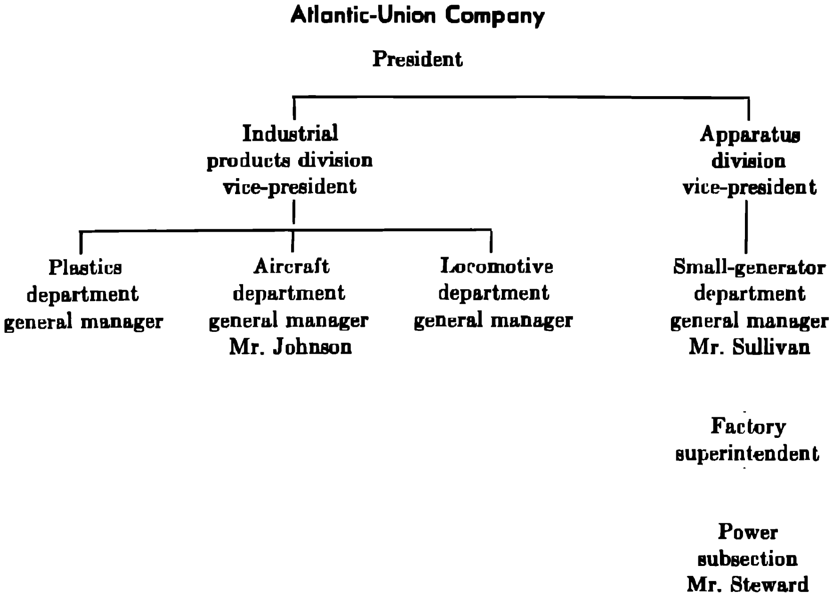
PROBLEM 31 ATLANTIC-UNION COMPANY (A)

In 1961, Mr. John Steward, supervisor of the power subsection of the small-generator department, a unit of the Apparatus Division of the Atlantic-Union Company, was under pressure to revise the method of charging other Atlantic-Union departments for electricity supplied them by the small-generator department's power subsection. His recommendation for change had received little attention by executives of the small-generator department.

The Atlantic-Union Company was an international manufacturing corporation with a large number of independently operated departments. Three of the independent operating units, the small-generator department, the locomotive-engine department, and the aircraft-engine department, were located in the same industrial center. Current annual sales of the small-generator department were $14,500,000. Locomotive-engine sales for the year were $45,000,000. The comparable figure for the aircraft-engine department was $15,000,000.

Exhibit 1 Atlantic-Union Company

Partial Organization Chart


Atlantic-Union Company
President
Industrial products division vice-president
Apparatus division vice-president
Plastics department general manager
Aircraft department general manager Mr. Johnson
Locomotive department general manager
Small-generator department general manager Mr. Sullivan
Factory superintendent
Power subsection Mr. Steward

In most respects each of these departments was a self-contained operating unit. Each department general manager had full responsibility for the profits of his department and authority over all its functions. Each department had as many sections as were required to perform its functions as an autonomous unit. Each section performed a separate function such as engineering, marketing, production, and operating finance. Each was under the control of a section manager or superintendent. The activities of some of these sections was divided into subsections, each with its subsection supervisor. Exhibit 1 indicates the character of this organization.

The power subsection of the small-generator department under Mr. John Steward as supervisor furnished electricity to the aircraft-engine department and the locomotive-engine department in addition to supplying the needs of the small-generator department. The power subsection had six generators in the small-generator department area with a combined rating of 51,000 kilowatts. Mr. Steward said that in his experience not more than 36,000 kilowatts ever was available at one time. Electricity produced by these generators was transmitted to substations located in different sections of the three departments. At the substations the electricity was passed through transformers to step down the voltage. Electricity with the reduced voltages was distributed to the points of final consumption.

The "demand" for electricity differed in the three departments. Mr. Steward explained that demand was the maximum amount of electricity that would be required continuously for any 15-minute period. While the demand for electricity by the small-generator department was much greater than that of the locomotive-engine and aircraft-engine departments, the total amount used was somewhat less than the other two departments. Exhibit 2 shows this. Mr. Steward went on to point out that the demand for electricity by the small-generator department was erratic. Extremely large quantities were required for short periods of time at infrequent intervals; this electricity was required for testing purposes. Sometimes this peak requirement would last for three or four hours. At other times it would last for a few minutes only. Mr. Steward believed that it was impossible to predict these peak requirements and that it was not possible to control them.

The total subsection cost of generating and transmitting electricity for one year was about $2,500,000. This cost was distributed between the three departments. Mr. Steward separated the cost of electricity used by each department into the cost of generation and the cost of distribution. The rate of charge for the electricity generated was 1.1 cents per kilowatt-hour for electricity consumed. The fixed cost of generation included such items as the depreciation of the boilers, generators, power houses, pumps, and valves. Salaries and wages for the operating personnel were classified as partly fixed and partly variable costs.

The subsection was responsible for maintenance, repair, and operation of the power lines to the substations and of the substations themselves. These distribution costs included salaries of maintenance personnel, depreciation on the power lines, and replacement costs of power lines. Depreciation of the substations and their equipment was a cost carried by the substation owners. There were 48 substations located at the small-generator department, 25 at the locomotive-engine department, and 28 at the aircraft-engine department. The small-generator department and the locomotive-engine department owned their substations. At the aircraft-engine department 10 of the substations were

Exhibit 2 Atlantic-Union Company

Demand for Electricity in Kilowatts by Departments for a Typical 24-hour Workday Period

Time	Small-generator department	Locomotive-engine department	Aircraft-engine department	Total
7 A M	3,800	6,900	6,800	17,500
8	5,800	9,300	9,900	25,000
9	6,900	9,000	10,500	26,400
10	12,000	7,100	8,800	27,900
11	13,500	7,500	6,500	27,500
12 noon	8,200	8,000	9,400	25,600
1 P M	5,000	10,900	10,500	26,400
2	18,000	5,200	5,000	28,200
3	10,100	7,400	7,700	25,200
4	8,000	8,000	8,300	24,300
5	7,800	8,200	8,200	24,200
6	6,500	8,100	8,200	22,800
7	6,100	8,000	8,100	22,200
8	5,900	8,200	8,700	22,800
9	5,800	8,300	8,300	22,400
10	5,300	8,000	7,900	21,200
11	4,000	7,300	6,700	18,000
12 midnight	4,200	6,200	5,600	16,000
1 A M.	4,000	6,300	5,700	16,000
2	4,000	5,900	5,600	15,500
3	4,100	6,100	5,800	16,000
4	3,900	6,100	5,700	15,700
5	3,600	5,900	5,500	15,000
6	3,500	6,200	5,500	15,000
	160,000	178,100	178,900	517,000

owned by that department. The remaining 18 substations at the aircraft-engine department were quite new and had been purchased and installed by the power subsection of the small-generator department. The power subsection made a distribution charge of 0.5 cent per kilowatt-hour of electricity consumed. This was in addition to the 1.1 cents per kilowatt-hour generation charge for electricity consumed. Thus each department paid a total of 1.6 cents for each kilowatt-hour of electricity the department consumed.

Mr. Steward was somewhat concerned about this method of distributing the cost of electricity produced to the three operating departments. In a conversation with Mr. William Johnson, general manager of the aircraft-engine department, Mr. Johnson said that he was not satisfied with the schedule of charges being levied against his department. He thought that the charge of 1.6 cents for 1 kilowatt-hour of electricity was excessive. He said that in total his department was paying more than its fair share. Mr. Johnson felt that since he was held responsible for the profit and loss statement of the aircraft-engine department it was proper that he have direct control over all its costs. He intimated that he would find other sources of supply if the situation was not remedied to his satisfaction.

Following his discussion with Mr. Johnson, Steward made a detailed study of the rates being charged by private companies in the state. He found that usually their charges were based on two main considerations, demand and usage. The following information was taken from a contract between Atlantic-Union's plastics department and a local utility. It defines demand as the peak power requirement of a consumer continuously for any 15-minute interval. This peak requirement was a fixed component in the charges. It could be reduced only at the beginning of a contract year. Usage was the total amount of electricity used in a month.

Atlantic-Union's plastics department contract with the Acme Gas and Light Company contained the following provisions:

The maximum electricity demand for any 15-minute interval would be 6,000 kilowatts. For this Acme was to be paid a fixed monthly amount of $19,200 (6,000 kilowatts × 200—an agreed-upon factor— × 1.6 cents per kilowatt).

At any time the plastics department exceeded the 6,000-kilowatt demand maximum, the demand charge would be correspondingly increased. (For example, if the plastics department at any time used 8,000 kilowatts for a 15-minute period, the demand charge for the balance of the year would be 8,000 × 200 × 1.6 cents, or $25,600 a month.)

With the demand maximum at 6,000 kilowatts, the $19,200 monthly payment would be the equivalent of 1,200,000 kilowatts consumed at a rate of 1.6 cents per kilowatt. If the total monthly consumption exceeded 1,200,000 kilowatts, Acme would be paid for the excess at the rate of 1.6 cents per kilowatt. If the demand maximum were 8,000 kilowatts, total monthly consumption would have to rise above

1,600,000 kilowatts before Acme would be paid more than the demand maximum charge of $25,600 a month. Again, any excess consumption would be at the rate of 1.6 cents a kilowatt.

Although Mr. Steward had the responsibility for meeting the power requirements of the three departments and the general supervision of the power houses, lines, and substations, he had no authority in the financial operation of the power subsection. Mr. Joseph Sullivan, general manager of the small-generator department, determined all the charges for power supplied to the other departments. On the basis of his study, Mr. Steward suggested to Mr. Sullivan that the method of allocating power costs to the three departments be revised. Mr. Sullivan seemed to see no need for changing the current pricing system.

QUESTIONS

1. Do you think the current pricing system should be changed? Why?
2. If you think the pricing system should be changed or modified what system would you recommend?

13
AUTOMATION

A. O. SMITH CORPORATION

The A. O. Smith Corporation was the largest producer of automobile frames in the United States. In the early days of its existence, it manufactured perambulators. With the advent of the bicycle, the company took up the production of that article rather extensively. In 1903, the first pressed-steel automobile frame to be manufactured in this country was produced by the A. O. Smith Corporation. The company expanded rapidly, and in 1920 started the erection of its second plant for the production of automobile frames. This plant was an outstanding example of the use of automatic machinery in manufacturing. So successful was the enterprise that the company applied the principles developed in this automatic plant to several of its other plants.

1. AUTOMATION—A NEW WORD

Somewhere in the period from 1945 to 1950 a new word emerged and established itself in the vocabulary of manufacturing industry. That word is automation. Several have claimed origination of the word, but it seems probable that it was invented in 1946 by Mr. D. S. Harder of the Ford Motor Company. It would appear that to Mr. Harder automation was descriptive of two aspects of mechanization of production processes. One of these was the automatic transport of materials and work in process from one automatically performed operation to the next, and the necessary repositioning of the work so that automatic performance of sequential operations on several machines was possible. The second identifying characteristic of automation as of 1945–1950 was automatic control, "feedback." Essentially this involves an automatic sensing of departure from a prescribed standard and either a signaling of the need for correcting the condition or automatic self-correction within the automatic device or system itself.

2. AUTOMATION—NOT A NEW CONCEPT

As concepts in actual application, neither of these characteristics was new. For years many textile machines had automatically shut themselves down (entirely or in part) if there was a breakage in the thread, the material in process being worked upon by the machine. Inherently, this was feedback control. Limited transport and mechanical positioning of work or tools for a few sequential operations on a single machine had been common practice long before the word automation was coined. The automatic screw machine and some automatic turret lathes are examples. What was new in the 1945–1950 breakthrough was the availability of a new type of sensing and control means, the electronic devices that had their origin in military equipment. Electronics gave a new precision and a wider range of application to automatic transfer and feedback control.

3. AUTOMATION, A DEGREE OF MECHANIZATION

Automation, then, is a degree of a long-practiced and much-discussed concept of manufacturing, mechanization. In his book, *Automation and Management*,[1] Professor Bright recognizes and defines 16 levels of mechanization. These start with the use of hand tools and progress through to the automatic machine which selects from a wide range of possible predetermined actions that one which is appropriate to the specific requirement, corrects its own performance to correspond to predetermined standards, and goes further by anticipating the need for action change or correction and adjusts itself to meet the presensed need. The lower of these mechanization levels pervaded the early industrial revolution. From these have evolved the more sophisticated levels of mechanization, culminating in the thus far highest degree of automaticity just described.

4. COMMON CONCEPT OF AUTOMATION

Today the term automation is applied to levels below that which Bright seems to consider to be the ultimate. As commonly used, automation refers to mechanization which includes automatic transport from work station to work station with automatic positioning of the workpiece and tools and automatic cycling of the operation at each work station. Automatic feedback control is characteristic, but by many is held not to be an essential characteristic of the automated operation. Automatic sensing of departures from normal and signaling of such departure or automatic self-correction may be considered as advanced stages or levels of the automation process.

[1] James R. Bright, *Automation and Management*, The Division of Research, Graduate School of Business Administration, Harvard University, Boston, 1958.

5. THE AUTOMATIC FACTORY

By the early 1950's, writers were forecasting, describing, and discussing "the automatic factory," a manufacturing establishment that would operate itself provided it were supplied with the necessary materials. In 1950 Prof. Norbert Wiener's *The Human Use of Human Beings* [2] was receiving wide attention. In it he foresaw the introduction of automation resulting in "an unemployment situation, in comparison with which . . . the depression of the thirties will seem a pleasant joke." [3] In 1952 John Diebold [4] wrote on the same topic from a somewhat different point of view. He, too, foresaw centrally controlled self-operating manufacturing operations. Others were making similar forecasts. The "second industrial revolution" was at hand. There had been a breakthrough of new concepts, new techniques. A glowing, yet frightening, workless world for human beings in our industrial society was in the offing.

But as already has been indicated, automation was not a new concept. Rather it was a new word describing current mechanization applications. Nor were these application concepts new. Actually the automatic factory was not a new development made possible by post-Second World War technological developments.

6. THE A. O. SMITH CORPORATION ENVISIONS AN AUTOMATIC FACTORY

In 1916 in Milwaukee, Wisconsin, the A. O. Smith Corporation was operating an automobile frame plant that produced 600,000 frames that year and employed 1,350 men in so doing. It was a profitable business. The U.S. Department of Commerce reported a total production in the United States of 1,617,700 passenger cars and trucks for the year 1916. A. O. Smith's share of the frames required for this output amounted to almost 40 per cent. Its position in the industry was strong and was growing stronger. The company continued to grow and in 1920 was the largest manufacturer of automobile frames in the United States.

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[2] Norbert Wiener, *The Human Use of Human Beings,* Houghton Mifflin Company, Boston, 1950.

[3] Four years later Professor Wiener indicated that he was less pessimistic on this score than he had been in 1950.

[4] John Diebold, *Automation—the Advent of the Automatic Factory,* D. Van Nostrand Company, Inc., Princeton, N.J., 1952.

In the A. O. Smith Corporation plant, frame parts were fabricated on semiautomatic machines which required the attention and control of skilled and semiskilled operators. In the assembly operation, a frame was suspended from a monorail. A group of men would push this frame to the first riveting station, where a rivet, previously inserted, was "closed" by the riveting press operator. The frame was then pushed along to the next riveting press, where a second rivet was "closed," and so on. Such operations were typical of the entire manufacturing process. The plant had a capacity of 4,000 frames daily when operating a single shift.

When the business of the company approached the capacity of the semiautomatic plant, the possibility of erecting a second plant of a greatly different nature was considered. Mr. Lloyd R. Smith, president of the company, was not satisfied with the accomplishment of the frame plant, profitable business that it was. Much of the work of the plant consisted of heavy handling. In the interests of efficiency, labor had been highly specialized and a large number of the company's employees were engaged in performing simple tasks, which required little skill and less thought. To Mr. Smith the whole proceeding seemed monotonous, clumsy, antiquated. He thought such simple physical tasks should be much more cheaply, more rapidly, and better performed by automatic machines. Machines did not grow tired, nor did monotony cause them mental fatigue with a resulting letdown in performance which made for lowered quality.

> An automatic frame plant that would run without men! That was our objective back in 1916 when we looked up from our contemplation of men doing things over and over again, day in and day out, to the engineering possibilities for absolutely automatic production of automobile frames on a faster, greater, and more profitable scale.[5]

Nothing of the sort had ever been done in American industry. Machines had been developed which were automatic in the performance of a single operation or a small group of simple operations: the linotype machine and the automatic screw machine were examples. But a complete plant to take in raw materials and eject finished product, automatically, without the aid of men, was a very different problem.

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[5] L. R. Smith, "A Great Accomplishment," *The Magazine of Business*, March, 1929.

7. AN AUTOMATIC FRAME PLANT IS DESIGNED

The first approach was over the drafting board. At a cost of $1,500,000 the plant was designed ten times, the first nine attempts were scrapped, the tenth was accepted. A patent application covering the automatic units of the proposed new plant consisted of 245 pages of brief and 65 pages of illustration. The output estimate was set at 7,000 frames a day, 2,000,000 frames a year, and the year 1916 witnessed the production of but slightly more than 1,500,000 passenger cars in the United States. The research engineers and the chief executives of the company believed that the plant would work, and that it would return a profit. If, however, it were built and did not work, it would take the A. O. Smith Corporation 10 years to pay off out of earnings of the old profitable semiautomatic frame plant, the indebtedness necessary to the erection of the proposed plant. From an industrial standpoint it seemed that the research staff of 400 had succeeded. The need for flexibility and progress in product design had been recognized. The product would be of superior quality because variations from standard could not occur since the plant would shut itself down upon the slightest departure from standard quality. From an engineering standpoint, Mr. Smith has stated, the project was a failure, for in order to turn out 7,000 frames in a day the plans called for the employment of 180 men in supervisory, control, and visual inspection capacities. It would also be necessary for a guide to accompany visitors through the plant and to make that unnecessary had been part of the original plan.

Just about that time the First World War came on, and dust gathered on the $1,500,000 worth of blueprints as the resources of the A. O. Smith Corporation were conscripted for the manufacture of aerial bombs. The company devoted all its effort to bomb production.

8. AN AUTOMATIC PLANT IS BUILT

During 1920, 2,227,300 automobiles and trucks were built in the United States. The following year that number fell to 1,596,800. The A. O. Smith Corporation had its old frame plant, capable of turning out 4,000 frames per one-shift day. It also had plans for a new plant of 7,000-frame capacity, plans which had been developed at a cost of $1,500,000. The management went to its bankers for advice. These men counseled caution—at least, temporary delay. Mr. Smith believed that there must be no delay. If the new plant were not built at once, it would be too late to reap the harvest which Mr. Smith foresaw in a greatly expanded automobile industry. Disregarding the advice of financiers, the management went ahead with its project, borrowed $3,000,000 for construction, and built its new plant. Practically all the equipment was designed by engineers of the A. O. Smith Corporation and was constructed under their direct supervision. The plant required two years for its construction and when completely equipped represented a cost, including design, of $8,000,000. The plant was planned to operate two shifts a day which would give it a daily capacity of 8,600 frames.

9. A TECHNOLOGICAL SUCCESS

The new automatic frame plant was a distinct success. The venture was a startling one, as can be inferred from the following statement of Mr. Smith.

> We will never forget two incidents, early in our production days, which are significant. The first is that moment when it became initially necessary for me or an associate to throw on the power. Both of us were stalling, one waiting for the other. Neither can clearly remember which one threw the switch. However, both of us and all of our coworkers recall vividly that for an hour and 57 minutes the unit functioned perfectly before it shut down—for want of material!
>
> The second incident grew out of our speculation as to whether a tried and trained crew of expert mechanics was necessary to the operation of the plant. And here again we make a confession that may add gray to our stockholders' hair. For there was but one way to find out, and we accepted it.
>
> A scouting of the streets, of the Salvation Army, of employment agencies, gave us a crew of absolutely inexperienced men. These we schooled for three weeks and at the end of that time sent them to stations on the night shift and we went home.
>
> Came dawn, as the scenario writers put it, and with it visions of destruction. Executives, engineers, and foremen, to say nothing of the regular crews, hastened to the plant, anticipating anything, hoping against hope.
>
> The inexperienced, untrained, "rookie" night crew had learned of the experiment. They had applied themselves diligently and had broken the day-shift record. The regular day crew took over from the rookies and carried on without a hitch.

10. AN EXAMPLE OF MODERN AUTOMATION

The new plant was so designed that it could be adjusted to produce all types of automobile frames then in use. With a single exception, all fabrication was entirely automatic. This one exception was in the department where steel strips, the raw material, were pickled. The corrosive action of acids and chemicals used in the process was so great as to make the use of expensive automatic machinery impractical because of the excessive depreciation of the equipment when subjected to the reaction of these chemicals. Originally, 180 men had been required to operate the huge, coordinated automatic machine. Continued study and improvement had reduced the number of workers to 120 by the year 1929, and output had been increased to 10,000 units a day. The men were principally employed at supervisory or inspection tasks. From the time the raw material came from the pickling room and was placed in fabrication, to the final inspection of the enameled, completed frame, no human effort was required for actual manufacture. The machine attendants were placed at various points in the several fabricating and assembly units to watch the operation of the machine, inspect its work visually, and, upon the completion of the subassemblies and the complete assemblies, to inspect the work by means of customers' gauges. At each point where an attendant was stationed, there was an electric control by means of which the entire unit could be stopped in the event the operator noticed an irregularity. It was impossible, however, for an attendant to start the machine again from his station. Operations could be resumed only from a central control point and then only upon a signal from all men at the various stations. Judged by 1962 standards this was automation: automatic transfer, automatic processing, automatic feedback.

11. PROVISION FOR PRODUCT CHANGE

In the construction of the various units, much attention had been given to the providing of flexibility of operation. All units were so designed as to facilitate changes necessitated by style whims of the buying public or by scientific and engineering advancement in automobile construction. A force of 500 expert die and tool makers was employed by the company to provide the automatic plant with the dies and tools required every time changes were made in frame design or a new type of frame was to be run. To retool the machine and change its setup, a crew of some 200 of these mechanics was required for a period of 8 to 10 hours. Minor changes and replacements of defective tools could be made without stopping the machine. The replacement of worn riveting sets, as an example, required ordinarily only 30 seconds.

12. SENSITIVITY TO QUALITY VARIATION

The ordinary automobile frame required 552 individual operations in its fabrication. When working at the rate of 10,000 frames per day, the plant thus performed in excess of 5,500,000 automatic operations so coordinated as to produce finished frames without excess or shortage of parts. The sensitivity of the automatic frame plant to variations in accuracy of performance is well illustrated by the experience of a day on which after three successive shutdowns the source of trouble was still undiscovered. "Finally (after an hour of search) we called every man to his station and threw on the power. A shout went up. A side rail was lifted from the line. A dulled punch had left a tiny burr of ragged metal on the underside—and the mechanism of control was so delicate that the whole unit was thrown out of operation as that burr passed to the next position."

The complete process was organized into nine separate units. These units were coordinated in their operation so that, in effect, the result was a single automatic machine. Any imperfection of performance or breakdown of equipment automatically brought about immediate shutdown of the unit involved. The whole process had been so carefully perfected, however, that such shutdowns were rare.

13. DESCRIPTION OF THE PROCESS

The nine units of the automatic plant were as follows: the material inspection machine, pickling department, side member manufacturing line, cross member manufacturing and assembly line, side member assembly line, final assembly unit, inspection line, enameling machine, and lastly storage. Exhibit 1 shows the layout of these nine units.

Raw materials were conveyed automatically from the car or warehouse to unit number 1. Here they were fed mechanically into a machine which inspected them for three dimensions as well as curvature. All imperfect strips were automatically rejected by the machine. From the inspection machine, the accepted steel strips were conveyed by monorail to the pickling department where a crew of seven men with mechanical equipment passed them through the acid, rinse, and oil baths. The latter gave them a light coat of oil, sufficient to act as a lubricant throughout the fabrication process. Transportation from the pickling department to unit number 3 was by monorail.

The third unit was the side member manufacturing line. It was made up of six presses, each performing a separate function. The operations included were:

1. Offsetting of the strips for the kickup over the rear axle and for curvature at the front and rear ends of the frames
2. Piercing of left-hand bars
3. Piercing of right-hand bars

This piercing consisted in making all openings in the side bars such as would not be distorted in the forming process that followed.

4. Blanking all bars, both lefts and rights
5. Forming of left-hand bars
6. Forming of right-hand bars

The six presses of this unit were driven by a single 500-horsepower motor to assure accurate timing and coordination of the presses and the intermediate conveyor systems.

The side member bars were mechanically conveyed to unit number 5, the side member assembly line. Here, the side members were automatically loaded in pairs on to trucks. These trucks were moved .intermittently down a 400-foot assembly line, stopping at 19 operating stations. At each of these stations several

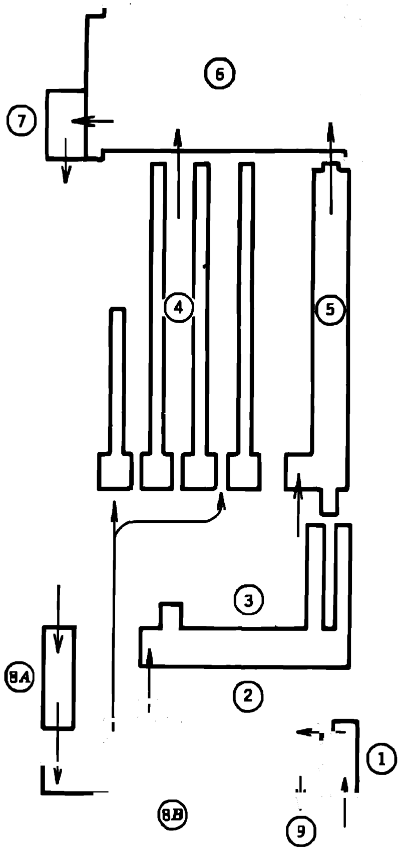

Exhibit 1. A. O. Smith Corporation. Diagram to Show Layout of Automatic Frame Plant.

1. Inspection Machine
2. Pickling Department
3. Side Member Manufacturing Line
4. Cross Member Manufacturing Line
5. Side Member Assembly
6. Final Assembly Line
7. Inspection

8A. Cleaning

8B. Enameling and Baking

9. Storage

operations were performed automatically, such as pinning and riveting brackets in place. As an average, 68 of these operations had to be accommodated. The line was driven by a single 200-horsepower motor.

Unit number 4 consisted of four cross member manufacturing and assembly lines. These lines were automatically fed steel plates from the pickling department. Each line included a blanking press, drawing press, automatic drilling machines, and small power riveting presses to complete cross member subassemblies. Each line was driven by a separate 100-horsepower motor. The steel was fed to the lines mechanically, and the cross members were automatically conveyed between the operations and fed into the various presses.

The side bar assemblies from unit number 5 and the cross bar assemblies from unit number 4 were brought together for final assembly in unit number 6. Here a mechanical device automatically assembled the complete frame and "nailed" the parts together with rivets fed through tubes from hoppers by means of compressed air. These rivets were automatically "set" by riveting machines at stations along the line at the rate of 90 rivets for each 10 seconds. The rivets were cold set under a pressure of 20 tons. To reduce the peak load of the unit as a whole, actions of the individual riveting machines were staggered. The 250-horsepower motor for this unit and much of the contributing mechanism were located on a subfloor beneath the assembly line floor. Just as with the manufacturing units and the subassemblies, at no time during the operation of final assembly was the product touched by human hands.

Upon completion of the final assembly in unit number 6, each frame was given a thorough inspection and was checked against customers' gauges. However, as there was practically no chance for error in the raw material or in the fabrication or assembly processes, there were few rejections at the point of final inspection. Inspectors from the engineering department made frequent detailed inspections of samples taken at this point.

Having passed the inspectors in unit number 7, the frame was transported by conveyor to unit number 8 where it was cleaned automatically, preparatory to painting. Hung on an endless chain 700 feet in length, the frame passed by a number of paint spraying guns and finally progressed through a two-story high-temperature baking oven. The baking time was generally one hour. When the frame emerged from the baking oven, it was a completed product.

14. STORAGE REQUIREMENTS

Conditions of manufacture at this plant were such that rather extensive storage facilities were required. For example, if the company had an order calling for a total of 120,000 frames to be delivered in monthly lots of 10,000 each, the usual procedure was to run through the entire order of 120,000 frames, shipping only on the agreed dates. Adjoining the automatic plant was a storage house 335 feet long, 216 feet wide, and 75 feet high. The lower 40 feet of this building had a storage capacity of 52,000 tons of steel. The upper portion held approximately 50,000 frames. Supplementary storage was available in adjoining yards designed to hold 100,000 frames. The storage unit and yards were completely equipped with monorail cranes to provide for automatic and mechanical handling of the finished product. Shipping docks had a loading capacity of 12,000 frames per 9-hour day.

15. RETENTION OF THE NONAUTOMATIC PLANT

While the new plant produced better frames, and produced them at a lower cost, the old frame plant was still a profitable enterprise and was retained. When the company received an order calling for less than 10,000 frames, it was the practice to produce the frames in the old plant. Likewise, if the automatic plant was overrun with orders, the surplus could be run in the old plant, using duplicate tools.

16. SUMMARY AND CONCLUSIONS

The automatic frame plant of the A. O. Smith Corporation was a success both technically and as a business enterprise. That the building of the plant was justified has been demonstrated repeatedly. It has proved itself a distinct profit-maker when operated at capacity. What is more significant is the ability of this huge automatic machine to show a profit when operated at much less than capacity. Success with its first automation venture motivated company management to expand the application of the concept into other manufacturing areas: an automatic welded pipe plant capable of producing 32 miles of pipe per day in sizes ranging from 8⅝ to 26 inches diameter, steel matting for embedding in concrete and mastic floors, pressure vessels, and other lines. These, too, were successful.

Why the A. O. Smith Company Was Selected for Discussion. The A. O. Smith automatic frame plant was not the first automatic factory to be operated in the United States. In 1784 a Mr. Oliver Evans designed, built, and operated a completely automatic flour mill near Philadelphia. So fully automatized was this operation that "absolutely no workers were required in the mill." But insofar as the author knows, the Smith frame plant was the first complete integration of automatic parts fabrication, subassembly, and final product assembly in this country. Furthermore, technically this plant was as highly automated as most automatic installations of today. Had its feedback processes resulted in the machine's self-correction rather than signaling malfunction, it would be classified as in Professor Bright's highest level of mechanization.

Automation is not a new development of our time; it is properly to be thought of as an advanced stage in the mechanization process that has gone on for years. To emphasize and to demonstrate this it seemed advisable to reach back some 40 years for the case to be included in this text. There have been advances in technical devices; a wider range of these is at hand for today's engineers than was available to the engineering group that conceived, developed, and built the A. O. Smith automatic frame plant. But there has been little advancement in concept, little overcoming of resultant problems.

Problems of Automation. Nor are today's reactions to automation and the automatic factory, as expressed in writings and public statements, new. Writing in *Fortune* in November of 1930, Mr. Stewart Chase said of the A. O. Smith company:

> I regard Milwaukee as the most dangerous area in the United States. It promises, in the persons of the Smith Dynasty,[6] to deal American industry a wallop beside which the late stock market crash was a chuck under the chin. Any determined adoption of its principles will turn the economic structure upside down and inside out, scrap billions of dollars of investment, shatter the nerves of untold bankers, and set the exalted profession of high-pressure salesmanship in a roadside ditch. But when

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[6] Lloyd Raymond Smith, president of the A. O. Smith Corporation, was the recipient of the degree of Doctor of Laws from the University of Wisconsin. At the time of conferring the degree the president of the university expressed as follows the reasons for granting it: "Because you have brilliantly dramatized the dependence of sound industrial development on sustained research; because you have brought to creative engineering a mind singularly emancipated from tradition; because in the readiness with which you have discarded obsolete methods and faced innovation unafraid, you have provided an example that should not be lost on those of us who bear a like responsibility in university, church, and state; because in the midst of technical triumphs you have shown a sensitiveness to their social impact on the lives of men and women who work; because you belong among the pioneers of a technical age in which machines shall lift the burden from the backs of men."

> the hurricane is over, we may find a world where poverty has disappeared, where robots are unheard of, where working hours have been cut in two, where waste is at a minimum, and where the era of the salesman has given way to the era of the engineer.

In the industrial history of the United States there have been many instances of progressive mechanization. An excellent example is the common electric light bulb. The manufacture of this fragile product is a complex production process. Many of the operations call for a high degree of precision. Production involves delicate assembly operations. Every unit produced is tested. Prior to 1920 some machines were used, but they were tended by trained workers and were not automatic. Assembly was a hand operation. The only truly mechanized step in the process was the exhaustion of air from the assembled unit. By 1925 product design changes had made possible automatic conveying of work in process and progressive indexing from work station to work station. The resulting pacing of the workers was the main effect. During the next 20 years steady progress was made in the extension of automaticity to parts production, subassembly of components, and final assembly. Still the process was not fully automated; there was no feedback control.

Mechanization during the 35-year period from 1920 to 1955 had increased worker productivity 1,700 per cent. We do not have a figure showing the effect on the number of workers employed in this activity for the same period. But from 1939 to 1955 workers employed increased 280 per cent, the life of the product turned out was substantially increased, its light-producing quality was enhanced, and price to the consumer was down. Probably the greatest fear that automation has engendered is the notion that it will reduce employment opportunities. That unemployment does not inevitably follow mechanization is demonstrated by what has happened in electric light production, a 280 per cent increase in workers employed during a 16-year period.

Objectives of Automation. The increase in mechanization activity since the Second World War in substantial degree has been caused by an inadequate supply of skilled labor and rapid rise in all wage levels. The urge to transfer the skill requirement to the machine and reduce the direct labor component in cost of manufacture was a natural result. The objectives of automation are well illustrated in the A. O. Smith case. These include increased output capacity, reduction in labor cost, a shorter manufacturing cycle, elimination of imperfect output, and in some cases, such as stamping and drawing, safer working conditions.

Deterrents to Automation. Why was not the A. O. Smith demonstration of gains to be had from automation quickly followed by widespread adoption of the concept? There were, and are today, many deterrents to such a high degree of mechanization. Often the investment risk is high and capital available for such risk taking may be costly. There can be many technological uncertainties, and obsolesence often is high in a rapidly developing technology. This means large fixed investment with a high break-even point, risks which taxation has been slow to recognize.

Until recently there have been no proved sources of automation equipment and design. A. O. Smith developed its own large engineering staff, principally because there was no other way to get the work done. Then, automatic equipment results in high maintenance costs; new maintenance skills must be developed and maintenance workers trained, sometimes a difficult and costly matter. The cost of "debugging" an automatic installation is high. Almost any new machine must undergo a break-in period when first operated. When an elaborate integration of automatic devices is installed, this initial "debugging" operation often is long and costly, usually more costly than management anticipates. After the equipment is in place and running smoothly, it is highly important that it be kept in constant operation. Because of high fixed costs, shutdowns are expensive. Down time must be kept to a minimum. A. O. Smith was fortunate in being able to make adequate profit when its plant was not operating at capacity. Nonetheless, maximum profit was attained only when operations were at or near capacity.

A. O. Smith illustrates another problem of automation, the high cost of alteration and retooling when changing from one product design to a different design. The reduction in number of direct workers from 1,350 to 120 was a drastic saving. On the other hand the automatic plant required 500 tool and die makers. These were highly skilled men whose wage rates were substantially higher than those of the displaced machine operators. Probably it is sound to generalize that while automation may tend to reduce the number of direct workers this often is offset in part, and sometimes entirely, by an increase in the higher-skilled indirect workers required. Many companies have found that their gains from automation have not been in labor costs. Frequently improved quality of product, reduction in defective output, lowered or eliminated inventories, quicker service to customers have been the sources of improvement.

Frequently automatic production requires more uniform, higher-cost raw materials. New supervision skills are required, and higher supervision salaries have been necessary. Often, products have had to be redesigned. The old designs and specifications were entirely satisfactory for nonautomatic processing. Automatic transport, indexing, assembly, and inspection required changes, sometimes costly.

If a product is made in small volume at any one time, if its design must be changed frequently to meet market competition and customer demand for style and the like, if change must be frequent or is unpredictable, such characteristics cause management to be hesitant about making the heavy capital commitments that are characteristic of highly automatic mechanization. Much automation tends to reduce flexibility. Probably this type of rigidity, as much as or more than any other deterrent, has been responsible for failure of the automatic factory to become prevalent in industry. In our free economy the outstanding market characteristic is the customer's freedom of choice. Any manufacturing concept that goes counter to this, in whatever degree the specific consumer situation dictates, will not be attractive to private enterprise managers.

In attempting to explain why automation has not "taken over" United States industry one must not ignore management's lack of knowledge of what has been done, is being done, and can be done. Since the Second World War our industry has been rather consistently prosperous. There have been "recessions," but these have tended to be short-lived and not of great depth. When "business is good," management rarely does anything drastic. This induces inertia. Certainly in the past few decades progress has become more prominent in periods of lower activity than in periods of high demand. When profits shrink, management seeks for ways of reducing costs. It is then that mechanization speeds up.

Need for Advanced Planning. All of which seems to indicate that successful mechanization at advanced levels must be accompanied by longer-range forward planning. Such foresight is not easy, and today many managements will deny its possibility "in their businesses." In many cases competition is likely to change this. The one real certainty is that the business world will change and that change will be increasingly rapid. How to live with uncertainty is the dominant problem of today's manufacturing management. This makes planning ahead essential. Tomorrow's process mechanization is an area of critical concern. Lack of knowledge or inertia too often spells failure.

Looking Ahead. The advent of electronic devices for control has carried automation into the office. In one sense electronic data-processing development is an evolution parallel to the evolution of the fully automatic factory process. Computers are faster than the mechanical hand-operated or motor-driven calculating machines that we have used for many years. Also computers are capable of performing a complicated series of mathematical calculations for which they have been set (programmed). They can "remember," that is, they can be programmed to select from a body of data more or less permanently stored within them. This ability of computers to perform a complicated series of interrelated calculations almost instantaneously and at very low cost has made for rapid development in the application of mathematics in business operations.

Currently automation is making progress at the "white-collar" levels. Much manual clerical work can and will be replaced by electromechanical devices. Mechanized payroll make-up, pay check preparation, and labor cost accounting is an integrated series that is prevalent. Inventory control and accounting is another area where mechanization is progressing rapidly. In many situations factory scheduling can be done better and more cheaply by the use of automation devices. And more recently through the use of sensitized or punched tape, office control of actual machine operation in the plant is making progress. Other applications of electromechanical controls inevitably will replace much of the past's clerical and manual labor at the office level.

Thus far this has resulted in little actual unemployment. More often it has necessitated an upgrading of clerical labor. The ability to obtain cheaply much more information for management's use has tended to increase the amount of clerical activity, thereby offsetting anticipated work-force reduction. The use of machine methods in the office has called for workers with new and more varied skills. Training has been necessary to meet these requirements, and as a result wage levels have tended to rise and little work-force reduction has occurred.

Another white-collar level at which automation is beginning to make progress is the so-called middle management area. Supervisors and department heads make many decisions of a routine nature. These decisions are repeated frequently. They often call for little or no judgment. Whenever conditions at *A*, *B*, and *C* are 4, 11, and 6 then do 21. If C is 8 rather than 6, then do 17. If *A* is 4 but *B* is 13 and *C* is 7, then the proper action is 23. To the extent that conditions at *A*, *B*, and *C* are quantifiable, decision making at this point is of routine determination. If the proper values are fed into a machine, or are stored in it so that correct selection only is required, the decision-making process can be mechanized. This is being done. But of course not all middle management decisions are of this nature. In many, the cause-and-effect relations have less certainty. We say that "judgment is required."

Mechanization of routine decision making at the middle management level will release superintendents and department and subdepartment heads from the necessity of much that is routine and will free their time for the making of better decisions which call for more judgment and intellectual and experience capacity. There is little evidence that machines will soon cause middle management activity to disappear. Again the indicated result is upgrading of required ability.

Top executives are just beginning to find electronic data-processing useful. Basically they find that the computer provides them with a wider range of possible solutions from which to select. The outstanding characteristic of top management decisions is that these decisions are concerned with uncertainties of the future. In the hands of skilled users, the computer can foretell the probable outcome if a certain set of conditions should exist. It can do this for whatever sets of conditions seem at all likely to exist in the future. The computer further often can provide some estimate as to which set of possible conditions seems more likely to come about. Thus the top executive has more information with which to work. But this does not mean that his task becomes easier. On the contrary, computers and their "programmers" will make life more complicated at the top executive level. The manager must make sure that the computer is fed the proper considerations (information), and the increased informational results made available to him by the machine make decision making more complicated. Also, as long as business enterprise involves the acts of people and operates in an environment where human choice is controlling, there are many factors bearing on decision selection that cannot be quantified. Here again we find that the results of mechanization call for an upgrading of the ability of the people responsible for the task, the managers. For some time past, the top executive has had to understand engineers and scientists and know how to use them. He has not had to be an engineer or scientist himself, but he has had to know when and how to use these specialists and how to judge their work and its results. To this facility tomorrow's manager must add the ability to use mathematicians. He need not himself be an expert highly trained in mathematics. Rather, he must be able to understand mathematicians, to know when and how to use them and how to interpret the results of their activity. With each succeeding generation the responsibilities of business executives become greater, their tasks become more involved and difficult, and the skills required of them become more varied.

That high degree of mechanization which we today call automation, whether it is on the factory floor, in the office, or at the top executive level, has much to offer business and, through business, society. At each step of mechanization advance, we will find problems. This has been true from the earliest days of the industrial revolution. It will continue. Today we often read or hear it said that our technological advances are outstripping our social progress. Essentially what this means is that our understanding of things exceeds our understanding of people. With respect to this unevenness of progress, the challenge to the business executive is clear. There is undoubtedly truth in the notion that things tend to hold the attention of the manager and that too often he "takes people for granted." And as usual the first step in correction of this is recognition of the problem. Automation alone never will serve the needs of a free society.[7]

QUESTIONS

1. "The oil-fired heating systems we long have had in our homes are a typical example of an automated process." Is this statement true? Explain.
2. What are the "objectives" of automation?
3. Why is not automation more prevalent in today's manufacturing industry?
4. Why has not the automatic factory come to dominate all production?
5. Why was an order to deliver 10,000 frames a month for 12 consecutive months run all at one time in the A. O. Smith Corporation automatic frame plant and then stored for periodic delivery?
6. Why did the company produce orders for less than 10,000 frames in the old plant?
7. The following information was compiled from the January, 1933, issue of *Motor* magazine and *Crane's Automotive Reports*, February 24, 1934.

Cars Specifying A. O. Smith Corporation Frames	*Number of Cars Produced in 1933*	*Cars Specifying A. O. Smith Corporation Frames*	*Number of Cars Produced in 1933*
Buick	41,800	Oldsmobile	36,705
Chevrolet	629,130	Pontiac	86,655
Franklin	1,965	Rio	9,987

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[7] For a more complete discussion of automation, see Eugene M. Grabbe, *Automation in Business and Industry*, Chaps. 1, 17, 18, and 19, John Wiley & Sons, Inc., New York, 1957. See also James R. Bright, *Automation and Management*, Harvard Graduate School of Business Administration, Division of Research, Boston, Massachusetts.

Cars Specifying Midland Steel Products Company Frames	*Number of Cars Produced in 1933*	*Cars Specifying Midland Steel Products Company Frames*	*Number of Cars Produced in 1933*
Auburn	4,519	Hudson and Terraplane	45,635
Cadillac-LaSalle	6,133	Hupmobile	7,317
Chrysler	26,240	Pierce-Arrow	2,425
De Soto	27,150	Plymouth	263,469
Dodge	118,894	Studebaker	48.504

Cars Specifying Own Make of Frames	*Number of Cars Produced in 1933*	*Cars Specifying Own Make of Frames*	*Number of Cars Produced in 1933*
Ford	476,500	Nash	22,075
Graham	10,987	Packard	9,670
Lincoln	1.938	Willys-Overland	38,650

In 1933 the A. O. Smith Corporation was the only company operating an automatic plant for the production of automobile frames. How would one explain the fact that in so competitive an industry as the automobile industry so many car manufacturers were not buying frames from the A. O. Smith Corporation?

8. Of what significance is the notion that automation is just a step in the more embracive concept called mechanization?

9. Under what conditions is the automation step of mechanization most likely to be appropriate?

10. Why has mechanization in the office been relatively slow in the past? Why has it recently become so much more rapid?

11. In 1957, 230 workers produced 1,200,000,000 of the glass bulbs used in the manufacture of electric lamps. If these bulbs had been produced by the hand methods employed in glass bulb production 30 years earlier, some 75,000 workers would have been required. What is the social significance of this change in production method?

12. Why have not the dire results of automation, foreseen by Mr. Stewart Chase in 1930 and by others since then, come to pass?

PROBLEM 32 A. O. SMITH CORPORATION (D)

One of the major products of the A. O. Smith Corporation was automobile frames. These frames were automatically assembled from pressed-steel side bars and cross members with malleable-iron or forged-steel fittings such as spring hangers. The assembled parts were automatically riveted in place, after which the frame was spray-painted and shipped or stored for future delivery. In 1927, the management was considering a method of machining spring hangers proposed by company engineers.

The malleables or forgings from which a spring hanger was made required several types of machining operations: milling, drilling, reaming, and tapping. A single part might require several operations of one or more of these types, a total of 10 or 12 operations being not uncommon. The number and nature varied with the size and type of part and frame. Variation in design was intensified by the attempts of automobile manufacturers to gain favor for their respective products through improvements and innovations in spring suspension. Ball-bearing shackles, rubber mountings, and better lubrication systems were examples.

In choosing equipment to turn out a spring hanger, the management was confronted with two sets of influences. The basic policies of the A. O. Smith Corporation demanded automatic machining of the parts. This would necessitate the design and construction of a special machine which would include all the operations of drilling, milling, reaming, tapping, and the like. The machine would be so designed that an operator would place a forging in the machine which would automatically convey it to the point where the first operation would be performed. The machine would automatically perform this first operation, transport the part to the next operation, position the part, perform the operation, send the part on to the next operation, and so on until the part was completely finished, ready for the assembly line. Such a machine would actually be an automatically coordinated combination of several drill presses and milling machines. The machine would have to be specially designed in order to get the desired combination of operations in proper sequence, with automatic conveying and positioning between the operations. Such a machine would require only a single attendant.

If this method of machining spring hangers were adopted, several of the special machines would have to be designed and built.

An alternative to the working up of such an automatic machine would be the use of standard equipment for performing the various tasks. None of the operations was uncommon, and none was of a character that would require costly equipment or labor. Simple standard machine shop equipment would do the work. Such equipment was readily available in the machine tool market.

Neither of the two alternatives entirely satisfied the management, and the problem was given to the company's research engineers. The result was the proposal that the company build a new device differing from the special-purpose machine already described in one respect only, namely, that the various operating units which performed the different drilling, reaming, tapping, and milling operations were to be interchangeable with each other on the machine base. The various operating units of the machine could be assembled for whatever number and order of operations a particular part demanded. For example, if a part called for two drilling operations to be followed by two milling operations, four additional drilling operations, two reaming operations, and two tapping operations, the necessary operating units would be assembled in that sequence above the revolving circular table which carried the part automatically from operation to operation. If the next part to be machined required a different sequence of other numbers of these operations, the standard operating units would be reassembled in the new sequence to do the work called for on the new part. Tool sizes could be varied at will within the limits of the requirements of the work. Once it was set up, the machine would be as fully automatic as a special-purpose machine. In fact, it would be a machine especially designed to produce automatically the one part called for. Just so long as it retained that particular setup it would be so specialized that it could produce nothing else; it would be strictly a single-purpose machine. But its parts could be quickly disassembled, rearranged, and reerected in such form as to do a quite different series of tasks. This would again make it a highly specialized machine designed to produce a different part until such time as its interchangeable component operating parts were reassembled.

The machine designed by A. O. Smith Corporation engineers would be capable of machining not only spring hangers but every cast and forged part used in the fabrication of the automobile frame.

QUESTIONS

1. What advantages did the machine designed by A. O. Smith Corporation engineers in 1927 have over the usual special-purpose and general-purpose types of machines?

2. In what ways might A. O. Smith engineers have sought to have improved on this new design?

3. In 1959 a prominent machine tool building company in the United States announced a new "revolutionary" machine for performing automatically drilling, reaming, boring, and milling operations in any predetermined sequence on all sides of a workpiece with a single setup. This machine held 30 standard cutting tools (drill bits, reamers, milling cutters, etc.) in a rotating tool magazine. Over 1,000 different types and sizes of tools could be mounted in the magazine. When signaled to do so this magazine would rotate automatically to bring any one of 30 tools into operating position.

The machine had a work table on which could be mounted a fixture for holding the workpiece to be machined. The table would rotate and index automatically to a predetermined position and would move automatically and precisely in a horizontal plane to bring the workpiece into contact with the cutting tool automatically selected from the tool magazine. Appropriate speeds and feeds would be automatically adjusted for each cut. Selection of tools, positioning of the table, and the cutting action of the machine were controlled electronically by a tape prepunched to signal the operations and sequences required by the part to be machined.

To operate this machine a worker would mount the work-holding fixture in proper position on the table and insert the punched tape in the automatic "reader" attached to the machine. Thereafter production on the machine consisted of placing a workpiece in the fixture and pressing a button. The machine then would perform the predetermined sequence of operations automatically until the part was completely machined. No attention was required of the operator until the machine had completed the work and stopped itself. The worker then would remove the finished workpiece from the fixture, place a new workpiece in the fixture, and start the automatic machine operating cycle. This would be continued until the entire lot of like pieces was machined.

By adding a second work-holding fixture the loading and unloading could be done while the machine was going through its automatic cycling. By adding a second tape reader to the two-table machine it was possible to eliminate all or most of the setup time required to change from one set of operations to an entirely different set of operations on a different workpiece.

Control tapes would be prepared by technicians in a planning group in the production control section. A separate tape would be required for each different part to be machined. Tapes would be prepared from engineering drawings of the parts. The time required to insert a new control tape in the machine's reading mechanism was approximately one minute.

Would this 1959 machine have been suitable for the machining of A. O. Smith small parts?

How does the 1959 machine differ from the machine design proposed by A. O. Smith research engineers in 1927?

In what ways, if any, is it superior to the machine proposed in 1927? In what respects, if any, was the 1927 proposal better?

14
LABOR SUPPLY

TUCKERMAN MACHINERY COMPANY

1. A MANUFACTURER OF HEAVY MACHINE TOOLS FINDS IT NECESSARY TO INCREASE THE SUPPLY OF WORKERS FOR THE FOUNDRY

For many years the Tuckerman Machinery Company had operated an apprentice school to provide it with the many trained workers constantly needed throughout its extensive plant. In the past an adequate number of the applicants for training had wished to prepare for jobs as foundry molders and coremakers. Recently the number of applicants for training for these jobs had become inadequate, and the company's personnel executives found it necessary to take active steps to supply the deficiency.

2. IMPORTANCE OF LABOR SUPPLY

No company can progress beyond the capacity and ability of its managers and its workers. Since the ascendancy of the machine in industry, management has too often lost perspective in this matter. This loss of balance in thinking is exemplified in the assumption that conflict between management and labor is inevitable. The idea that the one can prosper only at the expense of the other gives inadequate attention to the truth that neither can exist in the absence of the other. The productivity of the worker is largely influenced by the tools he uses. It is management's responsibility to supply these tools. The productivity of the machine is dependent on the ability and willingness of the worker to utilize the machine. Trite though these observations are, they are important, for the emotional reactions of vested interests—both labor and capital—continually obscure the basic truth. There are not two sound points of view; a business succeeds to the ultimate only as both labor and machines are productive. Suitable labor supply is fully as important as adequate equipment and proper raw materials.

3. CHARACTERISTICS OF LABOR SUPPLY

The employer in ensuring himself of an adequate labor supply must recognize the importance of three aspects of the problem: the number of individuals available to the company, the physical skills of available workers, and their mental characteristics.

The number of employables is the factor that is most commonly considered. Knitting mills are sometimes deliberately established in a community where the chief industry is the production of cutlery. Why? The cutlery shops employ chiefly men. The result is a considerable number of unemployed women and girls in this community who would welcome an opportunity for factory employment. Knitting mills use much female labor, and the drift of these mills to the cutlery manufacturing community follows. The significance of number of employable workers is obvious.

4. SELECTING WORKERS

Far too many jobs are filled on the basis of the applicant's being "a likely looking man." A young boy seeking factory employment for the first time had spent unsuccessfully many hours waiting at mill gates and in employment offices. Hot summer weather came on, and the youngster had his hair cut short and brushed it to a bristly pompadour. Two days later, he obtained an apprentice job in a department employing Polish grinders exclusively. Later the foreman said to him, "We have been needing a new hand for some time now. Yesterday, I saw you at the gate and I knew from the way you have your hair cut that you are a good Polish boy. That's why I hire you."

Procurement of industrial materials and supplies has been developed to the point where it is carried on with scientific care and exactness. The desirable characteristics of a material to be used for a specific purpose are painstakingly determined. If it is a metal that is needed, characteristics such as tensile strength, resistance to crushing, ductility, malleability, and elasticity are considered and the most suitable degree of each is carefully determined. Detailed specifications for materials are prepared, and when purchased materials are received, they are tested and meticulously checked for these specified requirements. Management has found from experience that such care in the procurement of raw materials pays.

Workers vary in their individual characteristics just as greatly as materials do. Worker attributes which are comparable to raw materials characteristics include such variables as strength, quickness, finger dexterity, and a wide variety of acquired skills. In choosing workers, some companies systematically analyze the worker characteristics needed for each individual job. Much progress has been made in developing techniques and procedures for preparing explicit job specifications. Comparable means for measuring the characteristics of the applicant for employment, fitness for a specific job, are not as well developed. Certain tests for dexterity, numerical facility, spatial perception, and the like are helpful and are employed rather widely. The ability to test and measure other important traits such as reliability and initiative is not nearly as far advanced. Unfortunately, too often management fails to make full use of such tools as are available.

No purchasing agent will select steel bars because they are likely looking steel bars. Too large a portion of industrial workers are hired on just that basis, particularly where foremen select the men to be employed in their own departments. Under this method of hiring, religious and fraternal affiliation, family relations, social congeniality, and the like are the common determinants of selection. Such a basis for selection is better than none, but certainly the way a boy combs his hair bears little necessary relation to his adaptability to precision grinding and finishing in a manufacturing plant.

Labor differs from raw materials in a most important respect: attributes of labor are dynamic while characteristics of raw materials tend to be static. If carefully selected materials are properly stored, they are likely to be the same tomorrow as they are today. They will be just as strong, just as workable, just as useful for their predetermined purposes a week or a month from the time they were purchased as they were the day they arrived at the receiving dock. That is not true of labor. Worker characteristics are constantly changing. Furthermore, an accepted applicant for a job may be willing to exercise his best ability at the time he is hired, and yet a month later he may be in an entirely different frame of mind about using his abilities. Management must recognize this dynamic characteristic of labor, this tendency to change. Executives must accept as a major part of their function responsibility for directing change in workers. Properly discharged, this function will produce constant worker improvement: increased ability of workers, greater physical stamina, greater skill, better mental attitude, and improved mental stability. If management ignores this responsibility or, recognizing it, fails to discharge it skillfully, the result will be low worker productivity, worker unrest, high labor turnover, and perhaps worker antagonism and strikes.

5. SECURING WORKERS

Existence of an adequate number of suitable workers in the vicinity does not in itself ensure an adequate work force. Workers must be attracted to the employ of the company. Various factors affect the willingness or desire of unemployed workers to get on the payroll of a specific company. The attitude of workers toward jobs offered is influenced by two types of consideration: conditions within the plant and outside conditions over which plant management has little or no control.

Companies quickly acquire reputations as being desirable or undesirable places to work. Liberal wages, steadiness of employment, able supervision, good working conditions, and fair treatment are typical of the internal influences which attract good workers to a manufacturing company. Whatever the company's policy in these respects, the community soon becomes aware of it and thereby develops an outside influence which will be favorable or unfavorable as workers and the general public in the community appraise the company's personnel management. No aspect of "corporate image" is more important than this.

Just as a definite opinion of an individual company is formed, so, too, public attitude toward types of work frequently develops. An industry may acquire the reputation of being exceptionally dangerous, or, over a period of time, of being nonseasonal in operation, thereby providing steady employment. Public opinion of this type will sometimes be a powerful force either for or against a specific company, even though that company may be an exception in its industry. However, it is sometimes possible for a company to capitalize on unfavorable working conditions in an industry by providing conditions which are relatively attractive in comparison with others in the same line of work, and thus secure the best workers of the type needed.

6. THE TUCKERMAN MACHINERY COMPANY'S PROBLEM

The Tuckerman Machinery Company, which manufactured machinery in a city of 175,000 population, employed approximately 5,000 workers. For 85 years, the company had conducted apprentice courses lasting for 1½ to 4 years for the training of machinists, draftsmen, patternmakers, molders, and coremakers. Until recently the company had experienced no difficulty in recruiting boys to enter these courses. For the past two years, however, few boys had applied to enter the courses in molding and coremaking, which were given in the foundry. There were 100 boys from sixteen to twenty-one years of age taking the company's courses. Six were taking the course for molders; eight, for coremakers; five, for patternmakers; twenty, for draftsmen. Four were studying to be screw machine operators, and fifty-seven to be machinists. Company executives wished to increase the number of foundry apprentices but had not succeeded in doing so.

7. HOW THE COMPANY OBTAINED SKILLED WORKERS

The purpose of the company's apprentice courses was to educate young men in all phases of their chosen trades so that they could qualify with the company as skilled workers and as leaders of those who had not had the opportunity to obtain a thorough training. The apprentices were trained to fill positions of responsibility and could look forward to promotions. In the past, the company's apprentices had been valuable additions to its force. Several of the department supervisors and many of the section foremen were graduates of the apprentice courses. Responsible positions under the factory superintendent and in the drafting, engineering, and sales departments also were held by former apprentices. All graduates had attained a degree of skill for which there was a demand in other factories manufacturing machinery.

8. THE APPRENTICE TRAINING COURSES

A grammar-school education was a prerequisite for all courses. For drafting, a boy was required to have, in addition, an education equivalent to completion of the course in the local technical high school.

Each boy who desired to enter the plant of the Tuckerman Machinery Company and who had the required prerequisites was given a preliminary examination to test his knowledge of simple mathematics, including fractions, decimals, percentage, ratio and proportion, square root, and mensuration. If the results of the examination and the references he submitted were satisfactory, the company set a date on which the boy was to enter the course.

The first 12 weeks after a boy enrolled in a course constituted a trial period. If the boy's work was satisfactory at the end of the period, he signed a contract, in conjunction with his parents and an official of the company, indenturing him to the company for the specified term of his apprenticeship. When he signed the contract, the apprentice paid a fee as an evidence of good faith. He forfeited this fee if he did not fulfill his contractual obligations. At the time of graduation, the company paid each apprentice a bonus considerably in excess of the original fee.

Company officials believed that the formal agreement and the payment of a fee were necessary in order to discourage the enrollment of boys who would not complete the courses. A boy who lived at home could save enough of his earnings during the three months of the trial period to pay his fee when the contract was signed. The company permitted boys who were unable to make full payment at that time to pay in weekly instalments. The fee varied according to the length of the training period. The fee for machinists and patternmakers was $50 and the bonus paid them upon completion of the course was $150; the fee for draftsmen was $25 and the bonus $75; for molders, the fee was $25 and the bonus $100; for coremakers, the fee was $25 and the bonus $50. At the end of the trial period, machinists and molders had to buy tools which cost $19 and $27, respectively. The company furnished tools during the trial period. The company paid an additional "merit" wage to those apprentices whose ratings, based upon the quality of their work, their scholarship, and their deportment, was "excellent." Length of service and wage rates for the various courses are given in Exhibit 1.

Exhibit 1 Tuckerman Machinery Company

Length of Courses and Rates of Pay for Apprentices

Apprentice courses	Length, years	Number of periods	Wage rates per hour: First period	Second period	Third period	Fourth period
Coremakers.......	1½	3	$1.20	$1.25	$1.35	
Merit wage.....			0.05	0.05	0.06	
Draftsmen........	2½	3	1.10	1.15	1.25	
Merit wage.....			0.03	0.05	0.06	
Machinists........	4	4	1.15	1.20	1.30	$1.35
Merit wage.....			0.03	0.05	0.06	0.06
Patternmakers....	4	4	1.15	1.20	1.30	1.35
Merit wage.....			0.03	0.05	0.06	0.06
Molders...........	3	3	1.25	1.35	1.45	
Merit wage.....			0.05	0.05	0.06	
Screw machine operators.......	2	4	1.25	1.30	1.35	1.45

The boys were given a thorough training in all phases of their chosen trades. Machinist apprentices studied centering, lathe work, drilling both by the use of jigs and where laying out the work was required,[1] milling, fitting, assembling, screw cutting, repair work, screw machine operating, and toolmaking. Boys in the drafting course studied a variety of work which included the designing of parts for all machines manufactured by the company. Patternmakers, in addition to making forms from the specifications of the designing department, spent a portion of their training period in the foundry. Molding apprentices were given experience in floor molding, bench molding, coremaking, and cupola practice.[2] The work of coremakers, on both light and heavy cores, included trimming and baking. Screw machine operators were taught to be specialists at setting up and operating all types of screw machines.

There was classroom work in connection with all the courses. Instruction was given in machine shop mathematics, including linear and angular measurement; calculation for screw threads, gearing, feeds and speeds of machinery; and indexing. The drafting of jigs, fixtures, cams, and other mechanisms also was taught. Company executives talked on problems of supervision. Supplementary instruction through lectures by men outside the company's organization gave the apprentices a knowledge of subjects of general interest.

9. THE SHORTAGE OF FOUNDRY APPRENTICES

For some time the company had been aware of a general shortage in foundry apprentices. This shortage continued. Most of the applicants for apprentice training did not want to enter the foundry course, and of those who did a majority quit within the first two weeks.

10. NATURE OF FOUNDRY WORK

All cast-iron parts for the machines manufactured by the company were cast in its foundry. The major operations in that department, which employed approximately 350 men, were molding, coremaking, melting, pouring, and cleaning.

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[1] Drilling by the use of a jig involved setting up the machine according to the requirements of a blueprint. No measurements on the material were necessary to determine the place to be drilled. Where there was no provision for a jig on the machine, the operator had to determine the point to be drilled in the material from the dimensions specified in the blueprint.

[2] The cupola is the shaft furnace in which pig iron is melted preparatory to casting. Pig iron, coke, and limestone are charged into the cupola near the top of its stack. The melted iron is drawn off at the base of the cupola.

Because of the nature of the operations, working conditions in the foundry were not so pleasant as in other departments of the plant. The work involved the handling of sand, bars of pig iron, iron scrap, coke, and limestone, and was so dirty that the workers made a complete change of outer garments in the morning before beginning work and at night before going home. Much of the work was heavy, particularly the carrying of flasks of sand from the molding bench to a point near the monorails. There was always danger of molten iron splashings. During the melting of metal, the furnace gave off obnoxious gases and smoke. The company, however, always had maintained as good working conditions as possible. A cement floor in all parts of the foundry eliminated dust to a large extent, and an adequate system of ventilation removed gases and smoke. Shower baths and working clothes were provided free of charge.

11. EXECUTIVE APPRAISAL OF THE SITUATION

Company officials had analyzed the dearth of foundry apprentices. The apprentice supervisor questioned all boys who were dissatisfied with the foundry courses. He learned that the boys considered the work too hard and dirty. Work in the other apprentice courses was cleaner and did not require the occasional heavy lifting that foundry work involved. There were no dust or fumes in the other departments where apprentices were trained. Other apprentices did not have to make a complete change of outer clothing when they arrived at the plant; they merely put on overalls and jumpers over their street clothes.

Company executives believed, however, that foundry conditions in the industry as a whole, and not merely in their company, were keeping boys from choosing foundry work as a trade. A large number of foundries were built directly on a hard dirt floor, and many of them did not provide shower baths for the workers. Those conditions had become generally known, and boys preferred either white-collar jobs or apprenticeships in the machinist trades. The high wages in the building trades also appealed to boys just out of school. A boy could learn enough of the carpentry trade in six months to be in a position to earn $10 to $14 a day. With the abnormal activity in building, opportunities for jobs in that industry were fairly numerous.

It was the opinion of the factory superintendent that blame for lack of workers in the foundry industry could be placed on all companies which operated foundries with poor working conditions. He believed that better conditions throughout the industry would break down the antipathy to foundry work which boys just out of school felt. The National Metal Trades Association had succeeded in pointing out the trouble to foundries in the Milwaukee district, with the result that radical changes for the better had been made in working conditions there. The results were reflected in an immediate increase in the number of boys who took up foundry work as a trade.

Company executives considered that there were two methods of increasing the number of applicants for foundry training: paying higher wages or seeking to bring about general improvement in working conditions in the foundry industry.

12. SUMMARY AND CONCLUSIONS

Origin of the Problem. Throughout the life of the Tuckerman Machine Company, the city in which it was located had grown industrially. There had been a steady increase in the number and variety of opportunities in factory employment open to each succeeding generation. At the same time, the number of opportunities for nonindustrial employment, particularly in service activities, had grown even more rapidly. As a result, industrial employers in the community had for years found it necessary to take active steps to obtain the skilled labor which local industry required. This was basically the origin of the shortage of foundry apprentices.

When the Tuckerman Machine Company needed additional employees, it had sought them in the local market. For years this source had failed to provide an adequate number of men of satisfactory skill. Particularly was there a lack of men who could eventually be promoted to supervisory positions. The remedy which the company had employed for many years was the apprentice training school.

The situation which the company now faced was simply the impact upon the training school itself of the very forces which had brought the school into existence. Potential applicants for foundry apprenticeship either were not having the opportunities in this field brought to their attention or felt that other employment offered more attractive opportunities.

Why the Problem Became Acute. For many years, compulsory public education and a long-continued rise in the standard of living had focused the attention of young people almost universally on white-collar jobs. Physical labor under none too pleasant factory conditions was relatively unattractive. Many sons of skilled factory employees were urged by their parents to seek vocations of greater social prestige. Parents were complacent when a son or daughter accepted employment at relatively low wages if the job held forth a possible future of greater social acceptance. Clerical work often seemed preferable both to young people and to their parents. The insurance salesman and the bill collector held positions of esteem.

By this time the effects of immigration restriction were being realized by manufacturers. No longer was there the lag of a generation between acceptance of physical labor, skilled and unskilled, and yearning for a white-collar job. The result was the beginning of a trend which still persists, labor shortage in certain skilled crafts.

The Tuckerman Machinery Company's apprentice school had been helpful to it in meeting this change. The school had a reputation for training excellent skilled workers. Its graduates were in demand by many companies. Usually the Tuckerman Machinery Company was able to retain its skilled apprentices, who realized the opportunities for advancement to supervisory jobs if they proved their ability as skilled workers. During the training course, apprentices received relatively good wages, and upon completion of their work they could make excellent earnings because their skill enabled them to command high rates and rapid promotion. Had it not been for its apprentice school, this company probably would have felt the effects of changing employment conditions more severely or earlier than it did.

Why the First Apprentice Shortage Realized Was of Foundry Applicants. If the foregoing analysis is correct, the impact of changed conditions on the apprentice school is readily understood. From the social viewpoint of the community, foundry work was the least attractive of any of the vocations in which training was offered. The work was heavy and dirty. Only the physically strong were capable of it. The relatively higher wage paid during the foundry training period could not combat community acceptance of the superiority of draftsmanship as a vocation. It was not "smart" to be a foundry worker. In social opinion, the draftsman was but one step removed from the engineer, who was looked up to as a professional man. Foundries employed considerable common labor. Common labor was not in evidence in the drafting room. To work in a foundry was to be known as an associate of common labor. To work in a drafting room was to acquire a "position" rather than to have a job.

The machinists and screw machine operatives were between these two extremes. Their work was less arduous and dirty. Many men of prominence in local plants had risen from these positions. If one was going to work in a factory, these vocations were more attractive than most. A first-class machinist could always get a good job at high wages, and a reputation of being a skilled machinist was worth having though difficult to get. Many a machinist was certain that he knew more and could do more than any engineer that ever came out of college. Many an older factory employee urged upon his son the security for the future enjoyed by a man skilled in the machinist's trade. And there was "good money" in it.

The shortage of foundry apprentices was the normal result of changed social conditions over which management of the Tuckerman Machine Company had little control. The problem of the company was to adapt itself to the new conditions. Good management makes such adjustments, expecting to be called upon to do so. Less able executives bemoan "the good old days" and berate the conditions which make for change.

What the Management Should Do. The suggestions for remedy considered by the management have merit. It is interesting that one considers change within the company while the other looks to improvement of external conditions. It is doubtful that either proposal alone would produce the desired result.

Increase in wages of foundry apprentices would make foundry apprenticeship more attractive. However, molders' wages were already the highest of the group, and there was nothing to show that the wage scale was the cause of the lack of interest. While higher wages for apprentice molders would tend to offset somewhat the adverse reaction toward foundry jobs, any reasonable increase could not be relied upon to bring a satisfactory number of applicants to the school.

Improvement in general foundry conditions would probably be more helpful. It would take time to bring about such improvement, and an even longer period would elapse before such improvement would influence general attitude toward foundry work sufficiently to overcome common aversion to it. It is also worth noting that if foundry conditions generally improved, the Tuckerman Machinery Company would lose any advantage it held in the past as a result of superior conditions in its own plant. A general improvement in foundry conditions is a desirable program as a long-run influence. While it could be expected to do but little for the Tuckerman Machinery Company for some time to come, the program should have been carried forward.

Two other possibilities deserve consideration. It is quite possible that the course of instruction offered to foundry apprentices could have been made more attractive. The case does not provide sufficient information to make decision in this matter possible. There are instances where change in methods of instruction and organization of materials have greatly improved the attitude of industrial apprentices toward their work. However, any such reorganization must not conceal the true nature of the work to be done, either during the training period or thereafter. Such deception is eventually fatal. There are many possibilities for honest improvement in teaching and instruction, and changes in instructing staff sometimes yield surprising results. The Tuckerman Machinery Company management should have investigated the matter fully.

The most promising partial solution to this company's problem would be a more careful selection and solicitation of candidates for foundry work. It is possible that the seemingly adverse features of the situation might be converted into assets. It should not be difficult to build up a reputation for foundry apprentices as being the physically superior group of the school, the "big boys," the "boys who can take it." Wrestling, boxing, and football could be employed to demonstrate this superiority. Such a program would require careful choice of apprentices for foundry work. A little money spent in adroit solicitation, perhaps through athletic organizations and clubs, should be effective. Once the foundry apprentice group had established a reputation for physical prowess, appeal and selection made on that basis would be very likely to produce desired results. If plant publicity were given to such a reputation, it would probably require a program carrying through into the foundry itself. Athletic superiority has more than once solved personnel problems for a factory. It might well do so in this case.

The importance of this suggestion lies in its constructive nature. It recognizes and accepts conditions as they are and works with them, rather than fighting them. The basis of the company's trouble was a social situation. The remedial means here suggested rely for effectiveness upon social reaction. Physical prowess is desirable from a social point of view. A better selection of foundry apprentices in terms of characteristics which bring forth social approval might well do what no practical amount of financial compensation or improvement in working environment could accomplish. Such a program is suggested as being well worth consideration by executives of the Tuckerman Machinery Company.

The work force can make or break a manufacturing business. A company's work force must always be in process of replenishment, and, therefore, a continuous supply of suitable labor is imperative. Numbers of employables indicate little as to labor supply. No two workers are exactly alike, and different jobs call for different worker characteristics. Job analysis to determine just what sort of worker is needed is helpful. It is even more difficult to analyze the applicant to determine if he meets the job requirements. Difficult as this task may be, the well-managed business undertakes it and in considerable degree meets with success.

The men on the job require just as much "handling" as the newcomers. Their physical capacities change, and, more important, their mental characteristics are highly dynamic. Thus maintenance of labor supply calls for two types of work: bringing the right men and women into the organization and then making and keeping them productive on the job. These two duties make up one of management's most difficult tasks—and probably the one which yields the greatest dividends in satisfaction when the desired results are attained.

QUESTIONS

1. What was the problem faced by executives of the Tuckerman Machinery Company?
2. What steps were proposed to remedy this problem?
3. How do you explain the distribution of the 100 apprentices among the courses offered? Why was so small a group electing foundry training?
4. What was the basic cause of foundry apprentice shortage?
5. Should the Tuckerman Machinery Company have attempted to improve its foundry labor supply by increasing wages?
6. Do you agree that it would be wise for company executives to work for improved conditions in foundries in the vicinity?
7. What are the characteristics of "good" teaching?
8. Would you expect a program designed to develop a reputation of physical superiority for the foundry group to be helpful?
9. Wherein is the personnel manager's job similar to that of the purchasing agent? Wherein are these jobs unlike?
10. Why is selection of workers more difficult than selection of materials?
11. What is the importance of the dynamic character of labor?

PROBLEM 33 ALBATROSS FOOD COMPANY, LTD. (B)

The Albatross Food Company, Ltd., a Canadian corporation, had gone through a period of great expansion, during which it had established a large number of retail food stores in several parts of the Dominion.

Throughout the company's growth, executives had found their most difficult problem to be the development and maintenance of an adequate supply of sales people and unit store managers. While constant effort had improved the personnel supply situation, the problem never had been solved to the satisfaction of the corporation's executives.

More recently the company had decided to expand into the supermarket field. While this would call for a supply of staff and managerial people more highly trained than in the past, the company executives believed that a carefully designed program for attracting and holding able personnel could be developed. One of the major executives was made responsible for planning such a program.

The Albatross Food Company, Ltd., began business as a small manufacturing and selling organization. After a number of years of restricted operation, the company entered upon an extensive developmental program which included the establishment of a large number of retail food stores in certain predetermined districts.

During this period of growth, company executives devoted practically all their time and energy to such problems as extension of activities into new cities, selection and acquiring of store sites, development of company brands, effective purchasing in large quantities, extensive advertising, establishment of effective retail prices, and financial programs. They gave little attention to problems of company personnel. There was a ruling that no one could became a store manager until he was at least twenty-five years old. In general, the policy was to hire clerks who were relatively mature. Men in the middle twenties were preferred. They seldom hired a man under twenty-four, and the average age of clerks was thirty-five years. One reason why the executives had adopted this policy was that such a course would make possible the rapid development of store managers and men for the more responsible supervisory positions, for which there was such great demand during the period of expansion that the executives often promoted clerks to store managerships after a period of only 12 or 14 weeks of service. Clerks worked on an average of 52 hours a week.

Wages paid to clerks approximated $45 a week, which was on a par with the rates competing stores were paying. Store managers received a regular weekly wage plus a commission on sales, the total amounting to about $75 a week. Store managers were transferred from one place to another as need arose. District supervisors were selected from the store manager group. District supervisors were paid a salary of approximately $95 a week. A district included approximately 12 stores.

The expansion program of the company proved sound. The volume of business transacted increased rapidly, and soon the Albatross Food

Company, Ltd., was generally recognized as an example of successful expansion. Company officials themselves felt well satisfied. They had laid out an aggressive program covering a period of years, and at the end of that time the territories in which the company had successfully established itself were even more extensive than originally had been contemplated. The executives were convinced, however, that there were no particular advantages to be gained from a further rapid increase in the number of unit stores. Rather, they felt that from then on their time and thought should go into the work of effectively solidifying their position in the territories in which they were already established.

As officials scrutinized their organization to see wherein it could be improved, they were repeatedly confronted by evidence that the personnel in their stores was not of the high quality they desired. The executives were disturbed by this situation and began an investigation of personnel conditions in their stores. This survey showed that the rate of turnover among their clerks was excessive, often reaching 70 per cent a year. Complaints from customers charged clerks with carelessness, inattention, and dishonesty. Shortages in store accounts were an outstanding cause of dismissal. A check of past records of clerks showed that a typical employee had held four or five jobs before entering the employ of the Albatross Food Company, Ltd. The investigation also showed that many times during the period of rapid growth the company had been unable to find efficient clerks in its own stores to promote to store managerships, and as a result had been forced to go elsewhere to get the necessary personnel. Officials were convinced that the company could improve its contact with the consumer public through the development of a better type of clerk.

In describing the kind of person that the Albatross Food Company, Ltd., wished to hire, one of the officials said: "We want a clerk who can meet the public in an agreeable manner and who, at the same time, is active and businesslike. He must be able to check figures quickly and accurately. I believe that a knowledge of foodstuffs on the part of each clerk is highly desirable. He, of course, must be honest with both the public and the company, and should convey to the customer an impression of real loyalty to the company. We wish that loyalty to be genuine."

It was obvious that there was a serious discrepancy between what the Albatross executive wanted in the matter of store personnel and what the company actually had as shown in the survey.

The company was also disturbed by the fact that the type of clerks which it was then hiring would not make efficient store managers in the future. Furthermore, a common practice among the managers was to keep good clerks in their stores as long as possible for purely selfish reasons instead of recommending them for promotion. Thus, the task of ferreting out the better clerks for positions as managers fell largely on the shoulders of the district supervisors. For selfish reasons, also, each district supervisor was anxious to keep in his territory all his first-class store managers.

In discussing the problems which confronted the company, a chief official expressed his belief that in the future the company should select its personnel from recent graduates of vocational schools. He pointed out that such boys had had the necessary training in arithmetic and that for one reason or another they were the type of boys who expected to spend their lives in vocational pursuits. He added that the vocational graduates usually came from families where the father was a mechanic or factory worker whose wages averaged $75 to $100 a week when he was employed.

The same official believed also that the company should institute training courses for all new clerks. The first part of the course should be formal instruction in foodstuffs. The second should be a probationary training in a demonstration store where the chief aim should be to teach the boy how to meet the public effectively. This training should extend over a period of two years. The official believed that under such a program, a graduate from a vocational high school course could look forward to becoming a store manager within a period of approximately four years.

During the following five years Albatross executives devoted much time to the development of better salesmen and managers in the stores. Wages at all levels were increased about 25 per cent.[3] While progress was made, the results fell substantially short of what the executives believed essential. Particularly unsatisfactory were the effects of their efforts to attract young men from vocational high schools. Those they did obtain were among the lower standing graduates who had experienced difficulty in getting desirable jobs in construction or in the plumbing or electrical service industries. Too many of the vocational school graduates hired by Albatross would, after a few months, leave to take jobs as delivery truck drivers or in warehouses and the like. Those who remained in the Albatross training program usually proved to be effective employees.

During this five-year period the supermarket made its appearance in Canada. In the United States these large-scale merchandisers of foodstuffs had been replacing the small chain store units for some time. In addition they had expanded their activities far beyond foodstuffs into cosmetic lines, clothing for men, women, and children, shoes, hardware, toys, drugs, greeting cards, and even into garden supply and floral shops. Some of the United States supermarkets had as many as a dozen leased or owned departments. Albatross executives believed that in the medium-sized and larger Canadian communities supermarkets would replace many of the relatively small chain units specializing in foods.

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[3] For example, district supervisors were paid salaries ranging from $120 to $145 a week.

The Albatross Food Company was perfecting plans for entry into the supermarket field. It had adequate capital for any foreseeable expansion, and its established reputation with the public gave it a substantial basis for successful operation. Company executives believed that once again their major problem would be personnel.

Study of the experience of several supermarkets in the United States caused Albatross executives to conclude that while they would have need for even more capable people in managerial and staff jobs in their supermarkets this could be made an advantage over their small-store situation. The leased department feature of the supermarket seemed potentially particularly promising. In many of these the profit mark-up on merchandise was much higher than the mark-up possible on canned, dry, or fresh grocery produce. Albatross could own the new departments, lease them outright, or finance capable potential leasees. A carefully worked out personnel program would be essential, but management believed it possible to develop such a program.

QUESTIONS

1. What reasons have Albatross executives for believing that the supermarket offered advantages in the personnel supply area?
2. What sources of personnel supply would you suggest that Albatross draw upon for its supermarkets?
3. Assume that you are an Albatross executive who has been made responsible for the developement of a personnel supply program for the company's new supermarket venture. Prepare a program which you believe would provide Albatross with the numbers of capable employees (salespeople and managers) required for a forecast total of nine supermarkets.
4. What effect, if any, can the supermarket program have on the personnel supply problems of the company's chain grocery stores?

PROBLEM 34 THE WICKLAND FACTORY NUMBER 1

Jack Smith was manager of manufacturing engineering at the Number 1 Wickland factory, one of the larger of 50 plants operated by the Mator Equipment Company. He reported directly to the manufacturing manager who reported to the plant manager (see Exhibit 1). His responsibilities included the specification of manufacturing methods and the determination of related time standards. He was also responsible, functionally, for the activities of the planning supervisors in the three product departments. These planning departments established the production method, the work routing, and the piecework prices for each part manufactured.

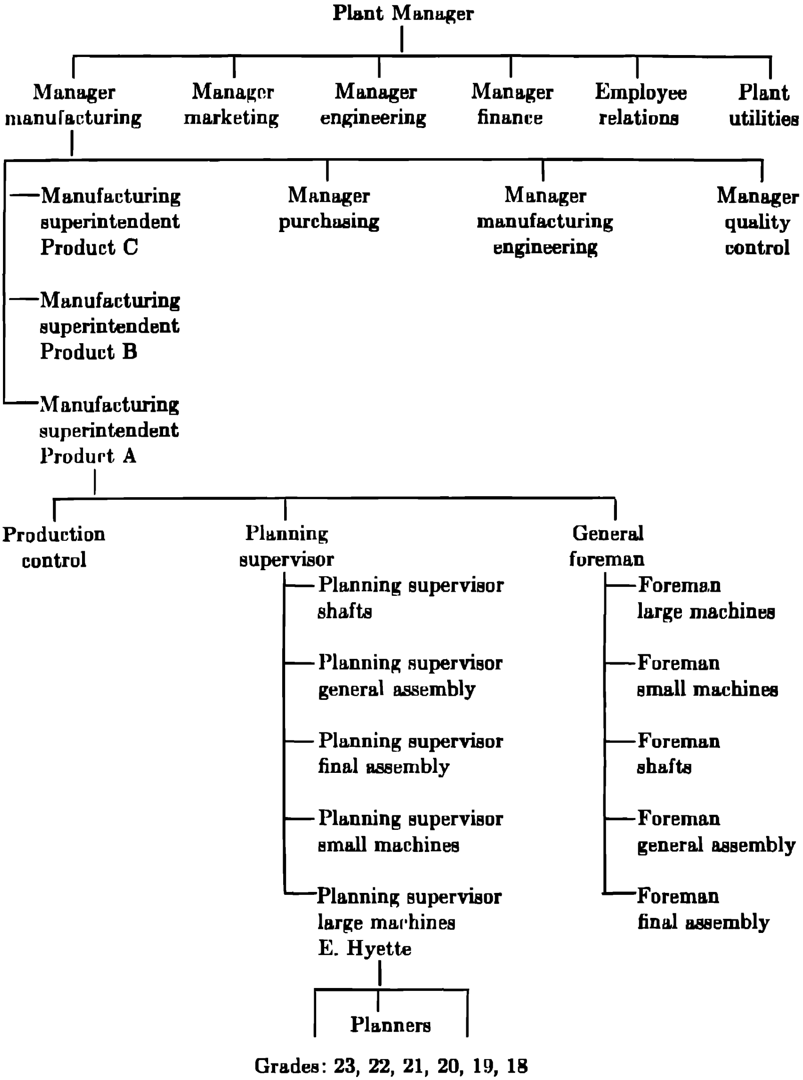
Edward Hyette, the planning supervisor for the large machines department (product A), was faced with high turnover of workers in the lowest job classification in his department (grade 18). He had 11 men working for him: two each of grades 23, 22, 21, 20, and 19 and one grade 18 man (see Exhibit 1). This unit was typical of the planning units throughout the company except that the others had no grade 18 personnel.

Jobs in the planning departments were assigned to workers on the basis of complexity. Grade 23 personnel were assigned highly complicated and diversified planning jobs; grade 22 planners were given complicated and diversified work; grade 21 men worked on diversified jobs; grade 20 workers did general planning; grade 19 men planned standard jobs; and grade 18 personnel assisted on miscellaneous planning work. Exhibit 2, page 376, contains job descriptions for the six grades.

Job grades were determined by considering the skill, educational background, experience, mentality, physical effort, and knowledge required to perform the work. In addition, the relative responsibility each job carried was determined on the basis of the risk of making errors and the cost of these errors and of making wrong decisions. Since wages for the various grades had to be uniform throughout the company, each planning job grade was compared with other jobs classified as 18, 19, 20, 21, 22, and 23 in terms of required skill, education, experience, mentality, physical effort, knowledge, and responsi-

Exhibit 1 Wickland Factory Number 1

Partial Organization Chart


Plant Manager
Manager manufacturing
Manager marketing
Manager engineering
Manager finance
Employee relations
Plant utilities
Manufacturing superintendent Product C
Manager purchasing
Manager manufacturing engineering
Manager quality control
Manufacturing superintendent Product B
Manufacturing superintendent Product A
Production control
Planning supervisor
General foreman
Planning supervisor shafts
Planning supervisor general assembly
Planning supervisor final assembly
Planning supervisor small machines
Planning supervisor large machines E. Hyette
Foreman large machines
Foreman small machines
Foreman shafts
Foreman general assembly
Foreman final assembly
Planners
Grades: 23, 22, 21, 20, 19, 18

bility. Accuracy of classifying jobs was largely the result of management's judgment and ability to compare the planning job grades with other company job grades already established.

Exhibit 2 Wickland Factory Number 1

Graded Salary Planning Jobs

Job Descriptions

Planning—Wage Rates—Methods—Grade 23

Highly complicated and diversified planning, methods analysis, development of basic data, and/or rate administration work involving the most complicated types and variety of manufacturing processes and procedures where an unusual amount of originality, ingenuity, and extensive experience is necessary.

Planning—Wage Rates—Methods—Grade 22

Complicated and diversified planning, methods analysis, time study, including the development of basic data, rate determination, and/or rate administration work involving a variety of manufacturing processes and procedures where originality, ingenuity, and broad experience are necessary. Generally leads others.

Planning—Wage Rates—Methods—Grade 21

Diversified planning, methods analysis, time study including the development of basic data, rate determination, and/or rate administration work involving considerable variation in manufacturing processes and procedures where complete information is not always available. May direct others.

Planning—Wage Rates—Methods—Grade 20

General planning, methods analysis, time study, rate determination, and/or rate administration work usually involving the application of known methods and procedures.

Planning—Wage Rates—Methods—Grade 19

Standard planning, methods analysis, time study, rate determination, and/or highly specialized wage rate work where procedures and processes are well established.

Planning—Wage Rates—Methods—Grade 18

Assist on any miscellaneous planning, wage rate, and/or methods assignments as directed. May make time study observations on operations where methods and processes have been completely developed.

NOTE: Definition is for identity only: it does not detail all operations performed or required.

The Wickland plant of the Mator Equipment Company was a job shop operation, manufacturing large equipment used by power companies. Work was dispatched to the factory floor by the production control department to meet the specific requirements of a customer order. For each part to be manufactured the production control department needed a routing slip and piecework prices for the several operations required on the part. The routing information was put on a card called a tag depicting the stock size and the flow from department to department. After the routing was prepared in a planning department, it was filed in the production control department until such time as the work was dispatched to the production department that would produce the part. For parts purchased on the outside, production control put the related purchasing information on a similar tag. This completed the tag file for all parts needed to manufacture the customer's order. For each part to be manufactured in the shop, a planning department prepared a planning card which listed the operations necessary to manufacture the part and the labor price for each operation, including the labor price for setting up the cutting tools and the machine. This planning card was held in the production control department and issued to the proper production department when the work was ordered into production.

The production control department dispatched work orders for all parts to be manufactured in the shop, arranged to have the material at the proper work station when needed, and specified the production method, operation by operation, and the corresponding piecework prices.

The planning supervisor was responsible for assigning work to the planners in his department. He assigned the most complicated work to grade 23 and the simplest of planning jobs to grade 19. To illustrate: part number 205369, a simple part, newly designed, was assigned to grade 19. The grade 19 planner first made out the routing tag. Next, he made out the planning card, indicating the list of operations and the operation sequence. He then broke each operation down to its individual elements. At this point, the grade 19 planner turned the work sheet and planning card over to the grade 18 planner, who by means of tabulated standard time data for the various elements completed the planning work sheet by filling out the time column. From the total time for each operation and a table of hourly rates, he calculated a piecework price for each operation. These piecework prices were then recorded on the planning card. This completed the planning department's task. The grade 18 planner performed this routine formula work for all grades of planning work, 19, 20, 21, 22, and 23.

The large machines planning department had developed standard time data for all elements involved in the operation of the lathes, grinders, milling machines, and drill presses used in the large machines production shop. For all work routed over these machines standard data were used by the grade 18 planner to determine the allowed time for the job in calculating the piece price for the job. Standard element times had not as yet been developed for other types of equipment in the large machines production shop. Data for these machines were being developed, and the planning supervisor expected that eventually standard data would be available and used for all operations in the department. The planning supervisor considered the use of standard data desirable. It reduced the amount of work for grades 19 and higher planners. It reduced the time required to train planners. It reduced costly human errors to the extent that planning quality was inherent in the standard data. When standard data were not available, individual time studies were made. Time and cost pressures frequently made these studies less exhaustive than those designed to develop standard element data.

Most of the grade 18 planner's work consisted of the application of standard element times to the routings developed by the other planners. If a wider standard data coverage was developed, the quantity of this work would increase.

For the past two years, grade 18 planners had been transferring out of the large machines department at the rate of four per year. The expansion of other planning departments and the creation of new planning departments enabled grade 18 men to move to grade 19 planning jobs in other departments. If a grade 23 planning position became available, it was filled with either a junior grade 23 man or a grade 22 man from this department or another planning department. By filling the open position from within, other job openings were created such that eventually a grade 19 planning position needed a replacement. The grade 18 planning man then became eligible and took the grade 19 job. Grade 19 planners were paid $102.61 per week; a grade 18 planner received $95.32 per week. This bumping and job filling from within was a requirement of the union agreement. All replacements (except for the grade 18 job) were men with some planning experience. Grade 18 openings were filled by personnel from the shop or from the outside.

There were three Mator plants within walking distance of one another at Wickland. Each manufactured quite different products, and each had its own planning departments comparable to those shown in Exhibit 1. There were 30 grade 19 jobs in these three plants. The one grade 18 job at the Wickland Number 1 plant was the only grade 18 planning job in the three plants. The other planning departments in the Wickland Number 1 plant and in the other two Wickland plants did not use the standard data method and included no grade 18 personnel.

The grade 18 planning job at Wickland Number 1 had been in existence for seven years. At the time this position was created, the planners were not unionized and job openings in the planning department were not posted. Although the normal turnover on grade 19 planning jobs had been two a year, the absence of the rigid "bumping" procedure had resulted in a less than comparable turnover on the grade 18 planning job. The manager of manufacturing engineering Jack Smith explained that the more recent high turnover on the grade 18 job was the result of the "economics of the situation." He said that the planning department for large machines had in fact become a training center for all three Wickland plants. The planning supervisor Ed Hyette and his higher grade planners had to spend a large portion of their time training new men. In addition, the new men made relatively more mistakes, which hurt the performance of the planning department and the operating departments served.

The manager of manufacturing engineering suggested that temporarily the grade 18 job classification be discontinued in the planning department. He would have all grade 19 (and perhaps grade 20) men do some grade 18 work. He recognized that this action had disadvantages. The grade 19 personnel might object on the grounds that the company was willing to pay more for grade 18 work and, therefore, they might request a proportional salary increase. He realized that the union might uphold this demand and charge that the company was setting precedent.

He considered the setting of precedence not serious because, to the best of his knowledge, there was no other grade 18 planning position in the entire company. He expected cooperation from grade 19 personnel on the strength of a situation that had occurred a year earlier. At that time, the union was sent the following notice: "Due to a lack of work for our two grade 19 jobs (in the large machine planning department), we are taking grade 18 work carried on by planning man X, grade 18, and dividing it between the two grade 19 men to give them full-time work. The grade 18 man has been transferred and will not be replaced. If, in the future, the volume of grade 19 work increases, we reserve the right to reestablish the grade 18 job." There was no adverse reaction from the union, and the grade 19 personnel gave enthusiastic cooperation.

Ed Hyette, the planning department supervisor, estimated that it took approximately three months to train a grade 18 planner. He estimated that during this learning period each new man made about five mistakes per day. These mistakes resulted in complaints from the workmen to the shop foreman. A workman's typical reaction was that management was cutting piecework prices. For example, when the planning department established the piecework price on a part to be 13 cents, the workman might claim that it should have been 14 cents. Quite frequently when a new planning man was involved, re-examination of the piecework rate would disclose that the workman was right. In addition to this, the new grade 18 men needed more supervision and time, not only from the planning supervisor but also from the higher-grade men who passed on formula work to a grade 18 man. According to the planning supervisor, the normal turnover rate for grade 18 planners should be one or two per year. He stated, "a siege of this sort (rapid turnover on the grade 18 job) over a period of months has created a great deal of uneasiness between us and the shop foremen and workmen. Top management will really be giving me a hand if they decide to put aside temporarily the grade 18 job."

In your opinion should the proposal of the manager of manufacturing engineering be adopted?

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JOB STANDARDS AND WAGE PAYMENT METHODS

HALLERTON MACHINERY COMPANY

1. AN EXPERIENCE IN INCENTIVE WAGE PAYMENT

The Hallerton Machinery Company was confronted with an increasing cost of production resulting principally from rising hourly wage rates. In an attempt to increase worker productivity, the company changed the method of wage payment for some jobs to piece rates set from past performance records. Many workers were dissatisfied with these rates, and production costs continued to rise. The management decided that a revision of the wage system was necessary. In the case of certain turret lathe operations a satisfactory solution was found in the adoption of a modified Halsey premium plan of wage payment.

2. THE NEED FOR INCENTIVES IN SECURING WORKER PRODUCTIVITY

In the preceding chapter it was pointed out that the work force is the most highly dynamic element of the production process. Regardless of how carefully a worker is chosen and how well he is suited to a particular job, his continued productivity can be ensured only by sustained constructive treatment. It is a function of management to make certain that the worker has full opportunity for exercising his abilities on the job and to stimulate the worker to a full utilization of his capacity. If this is not done and management rests on the assumption that, having been properly chosen and placed in the organization, the worker will automatically produce as a properly adjusted machine produces, the outcome will not be satisfactory to either management or worker.

3. INCENTIVE WAGE DEVICES

For many years factory workers were paid on a time basis, by the month, the week, the day, or the hour. The assumption underlying this method of wage payment is that the employee places his time at the disposal of his employer and it is the responsibility of the latter to see that the former is kept busy. The time basis of payment is still in use in many places and for certain types of jobs probably always will be used.

In more recent years there has been a general recognition on the part of production managers that time wages have certain serious limitations. All workers are not equally productive. Some have less physical and mental capacity for work than others, and they do not all possess the same desire to work. Under such circumstances it does not seem fair that the pay of the more efficient and more ambitious workers should be the same as that of the less efficient and the less ambitious. To meet this situation, the piece-rate system of wage payment was devised. Under the piece-rate plan, a pay rate is set for performing a given task, for example, workers assembling carburetors in a factory making automobile parts may be paid 75 cents for each carburetor assembled. A slow worker may assemble only 16 carburetors a day. His wage would accordingly be $12. A medium worker, assembling 24 carburetors, would receive $18, and a very superior workman, completing 32, would receive $24. Each is paid according to his productivity. This is the thought underlying piece-rate payment.

In recent years there has been a rapid development of modified piece-rate plans. These plans include three provisions: (1) that a normal daily output for the average worker is established; (2) that the worker is guaranteed a stipulated payment whether or not he attains this normal output; (3) that if a superior workman exceeds the task set as normal, he receives a bonus based on his productivity in excess of normal production. The purpose behind all these incentive plans is to get the worker to produce as large a daily output as possible. The employer is naturally much interested in high productivity of his workers, for it means that his machines are being used continuously and that his raw materials inventories are passing through the factory rapidly. Lack of capacity operation of machines and slow-moving raw materials have spelled bankruptcy for many a plant. The energetic production manager, therefore, does everything in his power to secure full worker productivity. A common device is the use of incentive wage plans.

4. THE LABOR GROUP OF THE HALLERTON MACHINERY COMPANY

The employees of the Hallerton Machinery Company, which made machined parts for several local industries, were recruited locally. The community was highly industrialized, and while the labor supply was large, the demand for labor was also great, and under ordinary conditions demand exceeded supply. The Hallerton Machinery Company employed unskilled, semiskilled, skilled, and some highly skilled workers. Because of competition of other factories for workers, it had been unable to get a selected group of employees, even though it had an efficient employment department. Consequently, a cross section in any one of its production departments would have shown some poor workers, some medium, and some superior.

5. WAGE CONDITIONS

In the early years of its existence, workers of the Hallerton Machinery Company were paid hourly wages. Confronted with rising wage rates, company executives concluded that steps must be taken to increase worker output. As a result many operations were placed on a piece-rate basis.

6. HOW THE PIECE RATES WERE SET

These piece rates were based on records of past performance supplemented by the experience of the foremen. The records consisted of departmental cost cards for each product and showed the unit labor costs by products for each department. From these records were calculated the times taken by workers in the past to do each job. These records showed that the time taken for any one task varied greatly. The foreman's experience was very helpful in determining from these variations how much time was to be allowed in the future for the performance of the task.

Foremen were helpful also in setting a rate to be paid for each completed task. The cost cards showed the hourly rates men had been receiving on that job. Each past hourly rate was scrutinized to determine whether it seemed to be in line with the type of work and the so-called "going rate" for that class of work in the community. If it was not, it was revised, and the revised rate was used in calculating the piece rate.

If from a study of the records it was decided that the average worker would do a certain job in 20 minutes, the question then arose as to how much he should be paid for that job. If $1.65 was considered a proper hourly rate for that work, the piece rate for the 20-minute job would be one-third of the hourly rate, in this case 55 cents. This method of setting piece rates was simple, inexpensive, and quick. It was the method followed in setting all piece rates by the Hallerton Machinery Company.

7. RESULTS OF USE OF PIECE RATES

In use, these piece rates proved unsatisfactory. Some rates were set too low and some too high. As a result there was growing dissatisfaction with them on the part of both workers and management. When the rates had been set too low, workers were inclined to accuse the company of exploitation. When rates had been set too high, the management was inclined to hold the workers responsible for the increased costs of production which continued to develop in certain departments of the plant. Finally, conditions reached a point where the general manager decided to revise the whole wage payment structure. An industrial engineer was put in charge of the work of drawing up a new wage system. With the help of assistants, he at once began making time and motion studies to be used as the basis of new job standards.

8. HOW THE NEW JOB STANDARDS WERE SET

Much preliminary work was necessary to ensure reasonable accuracy of the time studies. First, the work in process was divided in such a way that each machine always received the same kind of material. Next, a study was made of all drives, the feeds and speeds of the different machines, the tool holders, fixtures, and all other equipment that was used on the machines. Tools were tested in order to determine the best materials to be used in them and the correct methods of sharpening. After standardizing the entire equipment according to the tests which had been made, each operation was studied, the simplest, most advantageous methods of work performance were determined, the correct feeds and speeds were recorded, and the proper tools were designated.

When these preliminary details had been completed, workers were taught the best, least fatiguing, and most rapid method of performing each operation. This included instruction in the correct use of the equipment and drill in the exact motions to be employed. Finally, time studies were made of each operation as it was performed by skilled mechanics. Several studies were made of each operation, and observations were taken at various hours throughout the workday. From the data thus compiled, a standard performance time was calculated. This standard time was then increased by a carefully considered allowance for fatigue, relief periods, and interruptions not under the control of the operative. The result was a job performance time which could be used with confidence as a basis for a wage rate.

During these studies, effort was made to secure the cooperation of the workers being timed. Employees throughout the plant understood that the objectives were the determination of the best way of doing jobs and the setting of a standard of accomplishment that would be fair to the average worker in the company's employ. While jobs were being studied and work standards were being set, no attempt was made to set up either wage payment methods or wage rates. Both the engineers and the management preferred to treat wages as a separate problem. The objective of the job studies was determination of work methods and fixing of accomplishment standards. This isolation of the wage problem from methods analysis was sound. All too frequently the two problems are treated together and thereby confused. When that is done, no clear picture of either problem is obtained, and the results often are unsatisfactory. It is far better to study work methods and to fix job standards without considering wage methods or rates. If these are considered later as a separate problem, better results usually are obtained.

In setting work methods and performance standards, the character of the work force is important. Whether the best or average workers are studied, the results always will be applied to the work group which the company actually employs or can hire. To set standards on any other assumption is a mistake.

9. CHOICE OF WAGE PAYMENT METHOD

After the job studies had been completed, the question arose as to what method of wage payment should be used. One of the first jobs considered was that of performing certain turret lathe operations on cast-iron clutch spring sleeves used in automobiles. The industrial engineer favored the Taylor differential piece-rate plan.[1] He said that he had had remarkable success with this system. He thought that it was well suited to the particular turret lathe job, which was simple in nature and required only dexterity and watchfulness on the part of the worker. Turret lathe operatives in the past had been completing an average of 25 sleeve castings per hour. The time studies showed that this output was low, that with a little training and stimulus the average worker could easily produce 38 pieces per hour, and that a superior workman should produce between 45 and 50. Therefore, the engineer proposed that standard production be set at 38 pieces per hour as shown by the time studies, that provision be made to train all workers in the more efficient methods, and that two piece rates be established, one rate to be applied to all workers who did not attain standard, *i.e.*, 38 pieces per hour, and a high rate to be paid to all workers who attained or exceeded standard. The high rate would, he believed, stimulate the slow, inefficient worker. As a result, one of two things would happen: either he would increase his output so as to earn the higher rate, or he would become discouraged and quit the employ of the company. The engineer believed that either of these alternatives was preferable to present conditions. The high rate would act as a great stimulus, since workers who exceeded the standard would receive the high rate for all pieces produced. Thus, if a worker attained standard, *i.e.*, if he produced 38 pieces per hour, he would receive the high rate for all 38 pieces.

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[1] See Harold B. Maynard (ed.), *Industrial Engineering Handbook*, Sec. 5, McGraw-Hill Book Company, Inc., New York, 1956.

The general manager of the Hallerton Machinery Company did not agree that the Taylor differential system was best suited to turret lathe operations. He pointed out that the plan placed so great an emphasis upon the superior workman that its adoption might result in a serious drop in earnings for many of the workers and that general dissatisfaction might become so widespread as to jeopardize the whole plan of wage revision. He also emphasized the fact that since competition for first-class workers was so strong in the community, he had no reason to believe that the Hallerton Machinery Company could supply itself almost exclusively with superior workmen.

The production manager suggested as an alternative the adoption of a modification of the Halsey premium plan of wage payment. He had had experience with this system before coming to the Hallerton Machinery Company and had found it satisfactory. Under the Halsey premium plan, the production standard, or task, was set on the basis of performance as shown from past records. If a worker completed an operation in less than the standard time allowed, one-half the time so saved would be credited to him for a bonus.

The objection to the installation of the Halsey plan in this particular instance was that time and motion studies had already shown that past records of performance were no indication of what workers could do. Consequently, it would not be advisable to use them as a basis for payment.

After considerable discussion, it was finally decided to adopt a plan which was a combination of the Taylor differential and the Halsey premium plans. Turret lathe operatives were guaranteed a base rate of $1.80 an hour for this operation, irrespective of the number of pieces produced. The production of 38 pieces per hour as determined by the time study was recognized as the standard task. If a worker exceeded standard, *i.e.*, if he completed 38 pieces in less than one hour, he was paid for 50 per cent of the time so saved as a bonus for superior productivity. If a very superior worker completed 38 pieces in 40 minutes, he would save 20 minutes on the task. For producing the 38 pieces in 40 minutes he would receive $1.20 ($^{40}/_{60}$ of $1.80) plus 30 cents ($\frac{1}{2}$ of $^{20}/_{60}$ of $1.80), or a total of $1.50. This worker's earnings on this job would thus be at the rate of $2.25 an hour.

At the same time the company would benefit. If the worker produced 38 pieces in one hour he would receive $1.80 for the work and the labor cost per piece to the company would be 4.74 cents ($1.80 divided by 38). If, however, the worker produced the 38 pieces in 40 minutes the labor cost per piece to the company would be 3.9 cents per piece ($1.50 divided by 38), a saving of over .84 cent per piece. Under this method of wage payment the company always saved one-half of the dollar value of the time saved by the worker. If a worker failed to meet the standard output, the labor cost was high.

10. SUMMARY AND CONCLUSIONS

Importance of Accurate Data. The modified Halsey plan appears to have been a better manner of paying turret lathe operatives for the task in question. The evidence seems clear that the original piece rates did not act as an incentive to high output, largely because of inadequate methods employed in fixing rates. For this state of affairs the management, not the workers, was primarily to blame.

The case shows the need for accurate data on specific production operations before an incentive wage system is adopted. The failure of straight piece rates resulted not from the form of compensation—payment for each piece produced—but rather from an inadequate factual time basis upon which to set job payment rates. This is the advantage of the Halsey premium plan as adopted—monetary rates were to be based on standard job times, standards set by means of careful study procedures. Had the rates under the Halsey plan been based, as they commonly have been, on accumulated experience, there is no reason to believe that the results would have been at all better than they were when piece rates had been set on records of past experience modified by the judgment of the foremen. Once time standards were set by means of method and motion standardization and time-study techniques, there is little reason to believe that payment on the Halsey premium basis would be superior to straight piece rates. From the standpoint of the worker, the Halsey plan pays him only one-half as much per piece produced above standard as he receives per piece produced up to standard. In this respect Halsey is the opposite of the Taylor differential piecework plan under which attainment of standard increases the worker's return per piece produced. The straight piecework plan would have avoided what the worker might see as being penalized on all output above standard and at the same time avoided any of the motivation objections to Taylor differential foreseen by management. Under the straight piecework method the worker receives in full for his work; his compensation is in exact proportion as he produces.

From management's viewpoint one may raise the objection that direct labor cost per piece produced would be higher under straight piece rates. This is mathematically accurate. However, if management's cost objective is maximization of worker output as the means of attaining lowest total cost per unit of manufacture, the lower rates under Halsey premium could be more than offset by the lesser motivation effect of "half pay above standard."

Whatever the theory involved in the above, it is important to understand that today most workers–independent as well as union members–are opposed to any incentive plan that does not compensate workers in full for all output above standard. Many unions oppose all incentive wage forms. In other industries, unions are equally demanding that their workers be paid on an incentive basis. Where this is true, the opposition to "share the gain" is strong indeed. Today, most incentive plans result in full pay to workers for all output. Under these conditions management must look for gain from incentive wages to such items as fixed overhead, more effective supervision, and "fringe benefits." The last of these three items constantly is becoming a larger and larger part of the wage bill. High individual worker output tends to reduce this item per unit of output.

The question often is asked: Are incentive wages as a form of payment on the decline? This is an "unanswerable" question to which either an affirmative or a negative reply can be made with some degree of substantiation. It definitely has been demonstrated that under the best of operating conditions (a situation that rarely exists) wages based on time can give as high worker productivity as wages based on output. It also is accurate that commonly the output of workers under well-conceived and well-managed incentive payment systems is higher by 10 to 30 per cent than the output of workers who are paid only for the time they are on the job. It is generally conceded that in those cases where piece rates have been replaced by hourly rates the cause invariably is failure of management to maintain piece rates at proper levels and in realistic relation of one job to another.

A company frequently finds it necessary to employ more than one wage payment method in order to meet particular conditions in various parts of the factory. Such procedure, however, is not without its drawbacks. Several plans of wage payment, when used simultaneously, may increase the difficulties of administration. The amount of paper work in the form of records, production orders, job tickets, and payroll computations may become complicated. Workers are likely to be dissatisfied if they are unable easily to compare the basis of their own wages with those of their companions and friends. A clear understanding of the wage method on the part of the workers is very important.

Forms of Incentive Wages. Incentive wages are a long-standing concept of scientific management. Each year sees additions to the list of wage devices already in use. Some of these plans have general application. Space does not permit a description of these plans in detail. Much has been written concerning them, and information regarding specific systems is easily obtainable. Exhibit 1, page 390, presents in tabular form a comparison of important characteristics of the more commonly used plans. This table was compiled by the National Metal Trades Association for use of its members. Changes in job methods persistently tend to make job time standards obsolete. It takes constant and methodical attention and effort to keep job standards "in line."

In considering the relative merits of various wage incentive plans, it should be remembered that modern labor legislation guarantees practically every industrial worker a minimum hourly wage. If the worker's output on any incentive basis fails to come up to this minimum, he still must be paid the minimum required by law. In many instances workers on incentives are guaranteed base rates by their employers, base rates usually well above the minimum that has been established by legislation.

Group Bonus Plans. The fundamental idea underlying a group bonus is that when all members of a given group cooperate as a unit, the total productivity of the group is greater than when each employee works individually. It is basic to this idea that the members of the group be able to assist each other.

Nonautomatic cigar-making machine operatives frequently are paid on this basis. It requires three girls to operate one machine. If they work as a team, rather than as individuals, the hourly output of the machine is greater than if they do not help each other. The group is paid a rate for each cigar made, this amount being divided among the

Exhibit 1 Characteristics of Wage Plans

Wage plan analysis	Straight time (hourly)	Production bonus	Task and bonus (Gantt) (Diemer) (Baum) (multiple time) (standard time)	Ordinary piecework (contract)	Piecework with guaranteed day rate (Manchester) (100% premium) (standard hour)	Differential and multiple piecework (Taylor) (Merrick)	Premium (Halsey) (50-50) (Rowan)	Empirical formula premium (Barth)	Supervisory element (Bedaux Point) (Haynes Manit)	Efficiency scale (Emerson) (Knoeppel) (Bigelow) (Wennerlund)	Miscellaneous (Locker machine) (individual group) (Bigelow waste) (Lichtner quality) (Economy) (Parkhurst)
Standard determination	None	Past performance	Should be accurate	Must be accurate	Should be accurate	Must be accurate	Past performance	Past performance	Must be accurate	Must be accurate	Must be accurate
Task level	None	Low	Varies	Medium	Medium	High	Low	None	Medium	High	Varies
Incentive	Poor	Fair	Good	Excellent	Excellent	Greatest	Fair	Fair	Good	Good	Fair
Guaranteed day rate *	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Generally
Favorable to new employees	Yes	Usually	Yes	No	Yes	No	Yes	Very	Yes	Yes	Usually
Employee understanding	Easy	Easy	Hard	Easy	Easy	Hard	Easy (Rowan very difficult)	Extremely difficult	Hard	Hard	Extremely difficult. Some almost impossible
Payroll computation	Simplest	Simple	Very complex	Simple	Simple	Very complex	Involved	Very complex	Involved	Very complex	Very complex
Supervisory and indirect labor participation	No	Possibly	Only in groups	Only in groups	Only in groups	Only in groups	No (Halsey only in groups)	No	Yes	Usually	Possibly
Applicable to groups	Yes	Yes frequently	Possibly	Yes	Yes frequently	Yes occasionally	Yes occasionally	No	Yes frequently	Yes frequently	Yes

* Under minimum wage laws industrial workers are, in effect, guaranteed a minimum hourly rate When a wage plan does not guarantee a minimum in excess of the legal minimum, the minimum required by law is effective

This table is adapted from a similar table published by the National Metal Trades Association which has granted permission for reproduction members of the team on a predetermined basis. The speed of the machine, in terms of cigars made, is dependent on the operatives. The raw material, tobacco, is never absolutely uniform, and the tasks of the operatives require somewhat different abilities. As three girls work together on one of these machines, they gradually come to know each other's abilities and soon have shifted the jobs among the three so that each is assigned the work she does best. Then the nature of the operations is such that the girls can help each other. Particularly is this possible when a nonuniform supply of wrapper comes to the machine.

The desirability of getting teamwork on this job is shown by the falling off in output when, for any reason, the regular routine of a group is upset. If one of the regular members of a group is unable to work, the introduction of a new girl into the group invariably results in lowered output. The girls object strenuously when a group is disturbed. This is because they are paid as a group for the number of good cigars produced, and when a group is disrupted, production falls off regardless of the effort of the new team and earnings drop.

Situations such as the foregoing satisfy the basic requirements for successful group payment.

Group bonuses also are sometimes paid workers on assembly lines. Frequently the management motive here is only partly to secure teamwork. There is often little opportunity for workers to help each other when the jobs on the line are well balanced and when the workers are paced by the movement of a conveyor. Jobs are set so that each worker has about all he can do to perform his task before the conveyor takes the work on to the next operation. Still, in such circumstances there is occasional opportunity for one worker to help another temporarily, and as the earnings of the group are dependent on the rate of performance of the slowest operation on the line, the incentive to teamwork does exist to some extent even though the opportunity for it is not great.

The more dominant motive for group payment under such circumstances is ease of setting output standards. The work is evenly divided among all workers on the line, and instead of setting a task standard for each worker and computing each worker's earnings separately it is only necessary to fix the standard for the group as a whole. This is less costly because it requires much less clerical work in keeping track of workers' earnings.

Workers are less likely to approve of group payment for long assembly lines than they are for small compact teamwork situations. When workers do not know all members of the group well, each is likely to feel that he contributes more to the earnings pool than his associates. Constant change in group make-up is unavoidable, and when the day's output is low, discontent and grumbling are sure to follow.

Adverse worker reaction is responsible in considerable degree for the abandonment of group bonus payment by automobile manufacturers. It has been found that hourly wages and machine pacing of workers tend to result in equal output with less worker dissatisfaction.

Sometimes group payment produces unexpected but desirable results. Rubber overshoes are usually made (assembled) by a group of 12 to 18 girls and men working on a production line basis. These lines have mechanical conveying of the work in process, and the pace of the slowest worker determines the rate of output of the group as a whole. The group of workers is paid a predetermined sum for each shoe made. At the end of the day the total earned by the group is divided among the members of the group by a previously set ratio. If for any reason the line is shut down temporarily, each worker receives an hourly base rate for the amount of the down time. This hourly rate is less than the average hourly earnings when the line is in operation. With this method of payment it was always necessary for the line superintendent to keep an accurate record of all down time. Occasionally workers complained that they did not receive full time credit when a line was down. To eliminate this cause of dissatisfaction, the management installed a large electric time-recording clock at the head of each line where it could be plainly seen by the workers. The electric switch that started and stopped the conveyor line also controlled the action of the clock. When the switch was thrown to stop the line, that action automatically started the clock, which then ran until the switch was set to the position that started up the line. When the line started, the clock stopped. Thus at the end of each day the clock automatically registered the amount of time the line had been shut down during the day, and there could be no question as to the amount of hourly base pay each worker should receive because of line down time.

The installation of the clocks effectively stopped worker complaints that they did not get all the down-time pay to which they were entitled. It also had another totally unexpected result. The difference between hourly base rates of pay and average earnings when the line was in operation was substantial. The workers soon came to regard the running clock as a source of loss to them. Whenever the line shut down, the workers became "clock-watchers," and unless operation was resumed quickly they would complain directly to the supervisor and urge him to get the line started again as rapidly as possible. These groups became very effective in putting pressure on supervision to maintain continuous operation of the lines. From a management point of view, this of course was very desirable, for the payment of base rates to a group of workers when a line was down was a direct loss to the business.

The group bonus is a wage usually designed to foster cooperative effort on the part of a group of workers. Obviously, it is applicable only when conditions are such that cooperation is possible, or when substantial clerical savings are obtained. When the opportunity for group activity is lacking, for any reason, there usually is little to be gained by the use of this device. Group bonuses have been used rather indiscriminately, and many failures have resulted. When conditions are suitable, intelligent application of the group bonus will yield most satisfactory results as an incentive to increased productivity.

Productivity and Profit-sharing Plans. Closely related to group bonuses are a variety of plant- or company-wide incentive schemes known as "profit-sharing" or "productivity-sharing" plans. Under these plans, workers regularly receive hourly or weekly rates of pay.[2] Periodically workers receive supplementary payments, the amount depending upon the total output of the plant or the profit made by the company during the pay period. The period covered may be a month, three months, six months, or a year. The most common period in the case of profit-sharing plans is one year. Bonuses based on plant-wide production are usually paid more often; the month and the quarter-year are the more common periods.

Under profit-sharing plans the common practice is to distribute a predetermined precentage of company profits earned before taxes. Each worker's share is dependent on his regular earnings during the pay period or on the number of hours worked. Proponents of these plans urge that they have the advantage of paying workers in relation to a company's ability to pay. Also they point out that when a company is prosperous it is only fair that workers share in that prosperity. The most important basic objection to profit-sharing plans is the fundamental fact that economically workers are not in a good position to share losses. If a business is profitable over a period of time, workers come to regard the profit-sharing bonuses they receive as something to be expected regularly. They look forward to the bonus distribution and all too frequently spend it, either in fact or in their minds, before it is received. They incorporate the bonuses into their scale of living, and when profit failure comes along they suffer from it. Under those circumstances the profit-sharing bonus does not have great strength as an incentive to work.

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[2] Profit-sharing plans can be applied when workers are paid piece rates or individual bonuses. The use of profit sharing is not common in these cases.

Another criticism of profit-sharing plans stems from the fact that bonus payments may be omitted through no fault of the workers. Workers can contribute greatly to the success of a business. However, profits are dependent upon many other factors, some within the business but beyond the control of the workers, some external to the enterprise and entirely beyond the control of the management. Thus there are times when no amount of worker effort can offset such influences as unfavorable raw material prices, poor product design, or "buyers' strikes." These conditions may serve to reduce the effectiveness of profit sharing as an incentive. Certainly conditions can develop which would seem to make these plans unfair to workers. Nevertheless there are both working groups and executives who are enthusiastic about profit sharing.

Plant-wide productivity plans are an effort to gain some of the advantages of profit sharing and at the same time escape some of the objectional features of making worker compensation directly dependent on the presence or absence of profits. Bonuses paid under productivity-sharing plans are related to volume of output achieved by the working group as a whole for the pay period. Thus the existence and size of such a bonus is rather directly related to the efforts of the workers. Workers can see the influence of what they do on what they are paid. When such plans are successful, there is a spirit of mutual helpfulness and cooperation within the worker group rather than a spirit of competition which proponents of productivity-sharing plans consider to be a disadvantage of the far more common individual incentive plans. It should be observed, however, that productivity-bonus payments can be seriously affected by external business conditions or by poor management, either of which can adversely affect a company's sales and eventually the volume of production which the factory is called upon to get out. These plans do have the comparative advantage of relatively shorter bonus payment periods, and they can be less affected by short-time market variations and by certain factors which are not controllable by workers but which have an impact on company profits. Currently these productivity bonus plans of various sorts seem to be receiving somewhat more attention than profit-sharing plans. This may be because the economy has been in an expansive stage. What the future holds for these plans remains to be seen.

Essentials of Successful Wage Plans. Enough has been said to illustrate the fact that there are certain prerequisites to the successful operation of modern wage incentives. Three conditions should be particularly noted. First, the incentive itself must be suited to the job and its requirements. Nothing is gained by using an incentive device to induce workers to attempt the impossible, nor is an incentive wage valuable except as it increases, either directly or indirectly, the productivity of the recipient. This means that before a wage incentive plan is established, very careful study should be given to the problem of what constitutes a normal task and the various details which surround the performance of the job in question. Second, the adoption of an incentive plan should mean that previous arrangements have been made to provide a steady flow of raw materials to each worker in just the quantity and at just the times needed. It assumes that machines are kept in first-class condition so as to run at optimum speed. There is nothing that will strike fire with the average worker more quickly than to be stimulated by the possibilities of high earnings by means of a bonus, only to find that such premiums are beyond practical realization because of conditions over which he has no control. Third, experience has shown that if means are adopted to spur the worker to maximum productivity, the management must provide sufficient inspection service to care for any possible increase in defective work. It is only natural that when operatives are highly stimulated to increase production, quality may suffer somewhat. The modern production manager realizes this situation and makes provision for it. If conditions are such as to make inspection in relation to definitive standards and responsibility practical, usually it is possible to provide adequate quality safeguards. In some plants this is accomplished by means of incentives for quality. More will be said on this subject under Quality Control, Chap. 21.

Conclusions as to Incentives. Much has been written on wage incentives, and much still remains to be learned concerning them. The following statement, however, can be ventured: if the production manager understands that high wages can mean low labor costs, if he is willing that labor retain a worthwhile share of the increased productivity above a normal task, then there seems to be no great objection to using wage incentives. When, however, these devices are used—as they sometimes are—to speed up the worker without commensurate remuneration to him, they are merely instruments of labor exploitation and do not deserve the support of socially minded citizens. If wage incentive devices are used appropriately, intelligently, and honestly, they will result in high wages to the worker, low cost to the management, and low prices to the consumer. If they cannot or do not result in this threefold benefit, careful investigation will inevitably reveal serious managerial misjudgment somewhere along the line.

QUESTIONS

1. Why is management interested in having workers produce at maximum output?
2. What is meant by incentive plans of wage payment?
3. What are the objectives of such incentives?
4. Describe production conditions in the turret lathe department of the Hallerton Machinery Company.
5. Compare past records with job study as means of setting job standards.
6. Why is it important that job standard determination be separated from wage rate fixing?
7. Explain the Taylor differential system of wage payment.
8. Explain the Halsey premium system of wage payment.
9. Why did the general manager believe that neither of these systems was best suited to the turret lathe operations on spring clutch sleeves in his plant?
10. How did a combination of these two plans seem to be a solution to the problem? Do you agree with the Hallerton management on this point? Explain.
11. What are the advantages and disadvantages of group payment plans? Under what circumstances is their use likely to prove successful?
12. What are the essentials necessary to the successful operation of wage incentive plans?
13. What advantages are claimed for profit-sharing plans? What disadvantages?
14. The argument that profit sharing enables a company to pay its workers in relation to the company's ability to pay is sometimes advanced as an advantage of these plans. Be prepared to explain this argument and evaluate its soundness.
15. List some of the internal factors that can tend to offset worker effectiveness under a profit-sharing plan.
16. List some of the external factors that can have the same effect.
17. How can workers in a profit-sharing situation obtain bonuses they have not earned?
18. Compare profit sharing with productivity sharing.

19. What conditions should exist for productivity sharing to be successful?

20. What effect has increase in fringe benefits on the effectiveness and usefulness of incentive plans?

PROBLEM 35 FOXMAN COMPANY (B)

> The Foxman Company received an order from a well-known automobile manufacturer to make 10,000 steel pins (see Exhibit 1). The company had made similar pins on several occasions, but always in small quantity. As a general rule, workers were paid day wages. Company executives believed, however, that production costs for 10,000 pins could be lowered by establishing piecework rates as a basis of wage payment. Accordingly, they requested the shop superintendent to estimate such rates for the job in question. He was to base the piece rates upon the production costs of previous orders for pins.

The Foxman Company operated a large iron foundry, a forge shop, a pattern and woodworking shop, and a well-equipped machine shop. Although the company had been formed originally to manufacture street railway equipment, such as frogs and switches, managing executives had, over a period of years, extended activities until they had established an enviable reputation for designing and building special-purpose machinery, both hand-operated and automatic. The company made a specialty of producing machine parts, stampings, and iron castings for other manufacturers and was prepared to furnish engineering advice, to design machines and parts, and to supply patterns and models. It also stood ready to supply experienced crews of workmen for repairs on a wide variety of mechanical and electrical equipment.

Special machinery was frequently built on the basis of cost of material plus a flat hourly rate for direct labor. The labor rate, in such cases, was set sufficiently high to include burden and profit. Machines on which the company had had previous experience, machine parts, stampings, and castings were usually manufactured at a contract price agreed upon in advance. Prices were estimated by men of long experience from their knowledge of the materials, direct labor, and plant burden involved.

Workers on machine parts were usually paid straight hourly rates.

This method was used because the quantity of pieces involved was usually small. Whenever the quantity was sufficiently large, however, the management often inaugurated piecework rates for specific tasks. Company executives believed that this policy was particularly desirable in the case of their company because of the type of worker employed. A wide variety of products required skilled workmen sufficiently versatile to operate any standard machine tool and to assemble and adjust intricate mechanisms. The primary requisite demanded of such operatives was excellence of work rather than speed. For the most part they were inexperienced on routine production jobs where speed and manual coordination were required. The management decided, therefore, that, whenever these men were required to do any considerable amount of work wherein speed and manual coordination were primary considerations, they should be paid on a wage basis which placed particular emphasis upon speed.

The Foxman Company received an order from a well-known automobile manufacturer for 10,000 round steel pins as shown in Exhibit 1. Each pin was to have a total over-all length of 3½ inches. The shank, which was to be 3 inches long and ½ inch in diameter, was to have a ½-inch head, 1 inch in diameter. Such work was ordinarily produced on a turret lathe. In this case, the automobile company had specified that the pins should have center holes in each end and that the shank should be concentric with these holes to 0.002 inch. With such specifications, it was necessary to turn the pins on an engine lathe at considerably more expense.

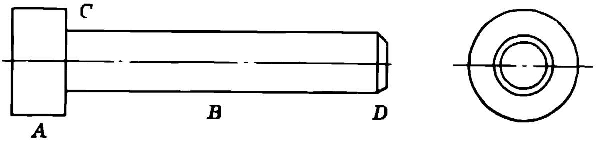

Exhibit 1. Foxman Company. Design of Round Pin.

The company had made pins of similar character several times before, but always in small quantities. Competition for the new order had been keen, and the management had been forced to reduce its initial price considerably. As a result of an existing business recession, the working force of the company had been considerably reduced and only skilled mechanics remained. Since circumstances surrounding the making of the 10,000 pins seemed to warrant it, company executives instructed the shop superintendent to establish piecework rates on operations where they seemed practical.

On examining the drawings, the superintendent found that the pin could be made from cold-rolled steel bar stock of 1-inch diameter. This steel presented a polished surface which made additional finishing of the head at *A* (Exhibit 1) unnecessary. The initial operation was limited to cutting bar stock to correct lengths for the pins. The work could be done on a cutting-off machine by a circular metal saw. Several bars were placed in the machine at the same time, and sufficient stock for one pin was cut from each bar at one setting of the machine. The cutting-off machine was easy to set and required about 20 minutes to cut off sufficient stock for 10 pins. A boy or the foreman could tend the machine during spare time. Consequently, the shop superintendent decided that there was no particular advantage in applying piece rates to the initial operation. The second operation called for drilling and countersinking the ends of each piece in order to provide centers for turning on a lathe. This operation also was very simple and fast. An apprentice working part time could easily produce enough to supply several lathe operatives. There appeared to be no substantial savings in applying piece rates to this task. The superintendent did believe, however, that piece rates were adaptable to the lathe work.[3] This task consisted of three cuts, two roughing and one finishing, on the shank *B*, a squaring cut on the head at *C*, and a chamfer at *D*.[4] A lathe operative would turn the shank *B* to within about 0.02 inch of finished size by the two roughing cuts. He would then change tools and square the head at C. The finishing lathe operation required another change of tools and consisted of making the finishing cut on the shank *B*. Lastly, the operative cut a chamfer at *D* with a file. Each of the three lathe operations would be performed on several hundred pieces before a change in tools was made. The chamfering operation would be done at the same time as the finishing cut on the shank.

Reference to the records showed the superintendent that the lathe operation on five previous orders had been performed by five different men. The production record and hourly rate of each man are shown in Exhibit 2. All these men had left the employ of the company, but the superintendent remembered them. Cannon was an expert diemaker and toolmaker; Briggs was a good machinist, efficient on production lathe work; Smith was a worker of little skill and small intelligence, usually acting as a helper; Tingle and Doras were high-class all-round machinists who usually acted as assembly men. With this in-

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[3] See "lathes" and "machine tools" in the *Encyclopaedia Britannica*.

[4] A chamfer is a narrow bevel at the intersection of two surfaces. Its purpose is to remove rough or sharp edges and in the case of pins to provide for ease in assembling.

Exhibit 2 Foxman Company

Wage Rates and Production Records

Employee	Hourly wage rate	Number of pieces	Total hours required
Cannon........	$3.80	815	135.83
Briggs.......	2.50	685	85.63
Smith..........	1.70	1,100	220.00
Tingle.........	2.60	550	78.71
Doras..........	2.80	110	12 22

formation before him, the superintendent computed the number of pieces per hour and the cost per piece for each of the five men. The results of his computation are shown in Exhibit 3.

Exhibit 3 Foxman Company

Calculation of Unit Labor Costs

Employee	Hourly wage rate	Pieces per hour	Cost per piece
Cannon........	$3.80	6	$0.634
Briggs	2.50	8	0.312
Smith.....	1.70	5	0.340
Tingle	2.60	7	0.372
Doras..........	2.80	9	0.310

The contract called for delivery of the entire order in six weeks. To accomplish this, the superintendent believed he probably would have to provide six men. He had available two production machinists and three all-round machinists who usually worked on machine assembly and intricate repairs. The superintendent doubted that these five men would complete the 10,000-pin order within the required delivery time. He disliked having them work overtime.

In considering what to do about this apparent manpower shortage, it occurred to the superintendent to consult a handbook of standard machine shop metal cutting times that recently had been given him by a machine tool salesman. He took the book home with him and spent the evening studying it.

This book had been prepared for and was published by an association of machine tool manufacturers and was said to represent the most common practice of machine shops using piece rates set by stop-watch time study on long-run jobs. Tables in the book gave allowable standard times for normally skilled workers by common machine shop job elements. The superintendent found that from it he could set a standard time for the machining of one round pin to the dimensions specified in the 10,000-pin order. Exhibit 4 shows his calculation.

Exhibit 4 Foxman Company

Stop-watch Standard Time for Machining One Pin

	Minutes
Mount and adjust piece in lathe	0.25
Mount and adjust rough turning tool	0.32
Rough turn, first cut	1.12
Rough turn, second cut	1.12
Change to facing tool and adjust	0.42
Square head	0.32
Change to finish turning tool and adjust	0.42
Finish turn	1.88
Chamfer	0.05
Remove piece from lathe and put aside	0.10
Total time to machine one piece	6.00
Allowance for interruptions, personal needs, and fatigue at 12.5 per cent	0.75
Total time allowed for one piece	6.75

A second calculation gave a total allowed time for one piece of 6.51 minutes if each pin were machined in three steps requiring three workpiece setups: step one, rough turn in two cuts; step two, square the head; step three, finish turn and chamfer. When performed in this fashion the second step, squaring the head, had an allowed time of 0.97 minute. The superintendent believed that done by itself this step might be excessively monotonous.

The superintendent realized that in setting a piece rate for the lathe work on the pin he could base the piece price on any one of three time standards: he could use a time determined from past performance; he could base the rate on the handbook time with all lathe work done with a single setup (Exhibit 4); or he might adopt the method of performing the task in three lathe-work steps using the handbook calculation for this which gave a total time for each pin of 6.51 minutes.

QUESTIONS

1. What piece rate would you recommend for this job?
2. Should the job have been put on piece rate?

PROBLEM 36 THE BROWNLEY SHIRT COMPANY (A)

The Brownley Shirt Company owned and operated a group of 22 sewing plants which produced men's dress shirts, sport shirts, and pajamas. The company produced men's dress shirts at the rate of up to 30,000 per day.

All the pressing operations on dress shirts were performed at 5 of the 22 plants. Customarily a girl with an electric iron pressed and folded a shirt, inserted a pasteboard collar form, a paper body wrapper, and pinned the sleeves and back in position so that the shirt was ready to be packed for shipment.

The company recently had completed the installation of five-station conveyorized pressing lines in one of the largest of its plants and was faced with the problem of deciding how the operatives on the new lines would be paid. In the past when each presser did all the pressing

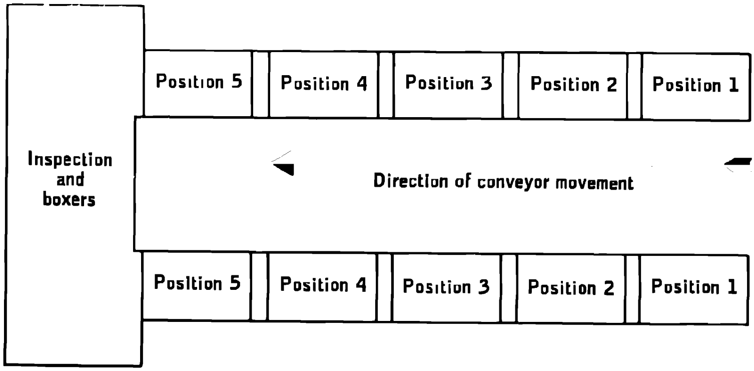

Exhibit 1. The Brownley Shirt Company (A). Diagram of Conveyor Pressing Unit.

required on a shirt, the girl pressers had been paid a piece rate for each shirt pressed. With the installation of the conveyorized system the pressing job would be broken down into five parts, and a girl would perform only one of these parts.

Exhibit 1, opposite, is a diagram of one of the two double pressing lines recently installed. Exhibit 2, below, shows the jobs at each of the five work stations. Each conveyor consisted of an endless chain of shirt-holding pallets that automatically and intermittently shifted from one position to the next, moving all the shirt pallets simultaneously from one of the five work stations to the next one.

As shown in Exhibits 1 and 2, each pressing line consisted of two conveyor lines that fed a single inspection and packing station. Each of the two conveyors had five stations with an operator at each station.

Exhibit 2 **The Brownley Shirt Company (A)**

Operations Performed at Each Work Station on Conveyor Line

Station No. 1

Operation 1: Obtain shirt, spray, obtain iron, press patch, put iron aside.
2: Button front and collar, lay shirt on pallet.
3: Position cuffs and press two cuffs.

Station No. 2

Operation 4: Get pin, insert in collar front, place collar form and center pin.
5: Place collar insert.

Station No. 3

Operation 6: Spray shirt front.
7: Press shirt front.
8: Remove collar form and pin, turn shirt over.

Station No. 4

Operation 9: Position packing tissue and board in shirt.
10: Finish fold, complete.

Station No. 5

Operation 11: Touch-up pressing.
12: Insert two pins, lay shirt on inspection table.

The conveyors were intermittently in movement and at rest. When the conveyor came to rest, a flat pallet like a small table top was in position in front of each operator. Each worker at once performed the pressing operations specified for her work station. A predetermined length of time was allowed for this work, after which the power-driven conveyor automatically moved all the pallets along to the next work station on the line. The time required for this movement was 0.02 minute. The timing of the conveyor movement could be adjusted by a maintenance mechanic. The 0.02 minute for movement from station to station was the minimum of which the conveyor was capable. The time interval during which the pallets were stationary was adjusted by the mechanic to meet the time required to perform the work of pressing a shirt when broken down into five tasks. In determining the speed at which a conveyor should be set, the methods engineers added 10 per cent to the observed work time as an allowance to take care of delays at the work stations. Thus the elapsed time required to press one shirt on a double pressing line with the job breakdown shown in Exhibit 3 was 0.44 min. × 110% + 0.02 min. ÷ 2, or 0.252 minute. In

Exhibit 3 The Brownley Shirt Company (A)

Actual Operation Times on Conveyor Pressing (Times in Minutes)

	Station					
Operation	1	2	3	4	5	Total
1. Obtain shirt, spray, obtain iron, press patch, put iron aside	.19					.19
2. Button front and collar, lay shirt on pallet	.19					.19
3. Position cuffs and press two cuffs	.06					.06
4. Get pin, insert in collar front, place collar form and center pin		.23				.23
5. Place collar insert		.12				.12
6. Spray shirt front			.06			.06
7. Press shirt front			.26			.26
8. Remove collar form and pin, turn shirt over			.10			.10
9. Position packing tissue and board in shirt				.255		.255
10. Finish fold, complete				.16		.16
11. Touch-up pressing					.18	.18
12. Insert two pins, lay shirt on inspection table					.18	.18
Total	.44	.35	.42	.415	.36	1.985

other words, a shirt came to the inspectors at the end of a double line every 0.252 minute.

The conveyors were to be in operation approximately 50 weeks a year. Style factors and seasonal demand peaks and lows made continuous operation at a steady rate impossible. The company's 22 sewing plants normally operated on a single-shift, 40-hour week basis. At times these plants operated less than five days a week. There was very little operation in excess of 40 hours a week as overtime was costly. In order to meet volume requirements the pressing lines frequently would be operated two shifts of 40 hours each. Two-shift operation was less costly than overtime work. Like other workers in the industry the sewing and pressing operators at the Brownley Company plants were accustomed to working short weeks in slack seasons and to occasional brief layoffs.

Studies showed that pressing lines would be in operation an average of 440 minutes an 8-hour shift. The industrial engineer who had been studying the work on the conveyorized pressing lines recommended that the pressing lines regularly be shut down for five minutes each hour. He said that this met the personal requirements of the workers and gave maintenance men adequate opportunity to keep the conveyors in good operating condition.

What should the management do about paying the girls on the new pressing lines?

PROBLEM 37 NORWICH CONFECTIONS, INC.

Norwich Confections, Inc., was a nationally known producer of premium-priced boxed candies. At peak demand seasons such as Christmas and Mother's Day the company had difficulty in meeting delivery requirements. Quality considerations limited production for stock as a means of meeting seasonal needs. An especially troublesome operation was chocolate dipping. The management had experimented with incentive pay methods as a means of increasing output on this operation.

A large portion of the high-quality candies produced by Norwich Confections, Inc., were chocolate coated. To ensure a thick, rich "enrobing" and attractive appearance, all coating of centers was done by hand. Girls performed this operation; at least three months' training was necessary for a girl to acquire the skill essential to good results.

Twenty-three girls were employed in the enrobing department. Each girl was seated beside a large pot of melted chocolate which was kept at proper consistency by an electric heater. In front of each operative was a tray of centers to be coated in a predetermined pattern. The girl picked up a center with the fingers of her right hand, plunged it into the chocolate pot, lifted it above the pot, and manipulated the upper surface of the coating to form the coating pattern required for the piece on which she was working, and as soon as the piece was cool enough to hold the pattern form she replaced it on the tray. This sequence was followed until all pieces on the tray were coated, after which the girl placed the tray on a nearby truck from which she brought a tray of uncoated pieces to her workplace.

The workroom was attractive, well lighted, and air-conditioned. The work was not strenuous, and the room was so arranged that the girls conversed with each other while at work. The room and equipment were kept immaculately clean; the girls were provided with fresh, attractive uniforms each morning. Several colors of uniform were provided, and each girl could select the color she wished. The management made every effort to make the work attractive, and the girls were well paid.

Despite these efforts, turnover of workers in the department had been high. Often a girl would partially complete the training program and then leave the company to take a job in a small retail confectionery shop where she would spend part of her time dipping chocolates and part of her time waiting on customers. Girls in these shops were paid lower wages than girls in Norwich's enrobing department. However, the jobs in the small retail shops carried "prestige," and some girls preferred them for this reason.

Norwich management had found that foreign-born Polish girls living in the community made the most satisfactory chocolate dippers. Usually they were members of large families, and a substantial share of their earnings was contributed to the support of the family. They preferred their weekly pay in cash rather than by check. Characteristically a girl gave her pay envelope with its contents of cash and earnings statement to her mother who managed the family finances. The mother gave a regular amount to the girl each week and retained the rest for the family funds. (She did the same with all employed members of the family whether it was the father or the small son with a newspaper delivery route.) If the pay envelope contained less than the usual amount, the girl was questioned and scolded. If the amount was more than usual, there was favorable comment but the girl's share remained the same.

The daily output of the girls in the enrobing department varied little. The girls seemed industrious, but once a girl had been trained she "hit her pace" and week by week her output remained constant.

Girls in the dipping department were paid hourly rates. A few of the most skillful girls were paid 10 cents an hour more than the others. There seemed to be almost no effort by the girls to get into the higher paid group.

Because good experienced dippers were hard to obtain, and at times unusual effort by the enrobers was desired, the management had experimented with various incentive wage plans in the department. Piece rates had not been effective in stimulating output. The girls would produce enough so that their weekly pay approximated their usual take-home but no more. At one time the department foreman instituted a weekly departmental bonus. When the output of the 23 dippers exceeded a predetermined output standard, a bonus was paid for output above standard. For a week or two output increased to well above standard but then dropped back to the level obtained before the bonus was instituted. Pay incentives had no sustained effect.

Recently the foreman had attempted a different approach. He offered a prize of a pair of nylon hose to each of the three girls whose output was highest for the week. Much to his surprise this had stimulated production greatly. He asked one of the three winners why she was willing to work so much harder for a pair of hose and was told that no one else in the family wore her size.

After several successful weeks with the nylon prize program, the output of the girls began to fall off and soon was at the level obtaining at the time the prize program was instituted. The foreman went over the payroll records of the five weeks during which the hosiery incentive program had been effective. He found that the 15 pairs of hose awarded during that time had been won by five girls and that two of the five had won nylons each week.

As a result of his investigation the foreman proposed a new incentive plan for the chocolate dipping department. A standard daily production would be established for dipping. Records would be kept of each girl's output. On any day on which a girl's production exceeded standard, the girl would be given a coupon representing the amount of her output in excess of the standard. The coupons would not be included in the weekly pay envelope but would be distributed daily on the afternoon following the day on which the coupon bonus was earned. Each coupon would carry the recipient's name; coupons would not be transferable. The company would arrange with a local department store to redeem the coupons in merchandise of the girl's choosing. A girl could accumulate coupons as she saw fit. She could not exchange them for cash. The company would reimburse the department store for merchandise exchanged for coupons.

The foreman explained his proposal to the plant superintendent. He told the superintendent why he believed the plan might work. The superintendent said that the scheme seemed "interesting," that he would discuss it with company executives, and that he would let the foreman have a decision promptly.

QUESTIONS

1. Should the superintendent approve the foreman's request to try out the new plan? Do you think it would be effective? For how long?
2. Why had the previous incentive plans failed in the department?

PROBLEM 38 BELLOWS METAL COMPANY

The foreman of the milling department of the Bellows Metal Company had to determine how to pay machine operatives until piece rates for their new jobs were set. These operatives had been earning $2.50 an hour on a piece-rate basis. The jobs on which they had been making these earnings, however, had been discontinued when the company installed new milling equipment, and the men had been transferred to jobs connected with the operation of the new equipment. The hourly value of the new jobs had been set by the standards department at $2.30, which was the same as the value of their previous jobs. Permanent piece rates could not be set, however, until the new equipment had been "broken in" and the operatives had become accustomed to their new jobs.

The Bellows Metal Company manufactured small metal parts. The company was located in a metal-working center in which there was currently a great demand for experienced operatives of metal-cutting and metal-forming machines. The company paid piece rates to its milling department workers. The rates were carefully set from time-and-motion studies and studies of wage rates in the community. The time-and-motion studies were used to determine the amount of work which the operative on a particular job should turn out in an hour. The community wage rate studies were used to determine the value of the job. The piece rate was determined by dividing the number of pieces the worker should produce per hour into the value per hour of the job.

The standards department, which made all time-and-motion studies, had found that workers did not expend as much effort or produce as much when on an hourly-rate basis as when on a piece-rate basis. Usually the installation of piece rates increased output 10 per cent. Consequently earnings of operatives were approximately 10 per cent greater on piece-rate jobs than on jobs having the same value but on an hourly-rate basis.

When workers were learning new operations or were learning old tasks on new and different machines, they usually had been paid an hourly rate. Temporary hourly rates were determined by department foremen who endeavored to set them so that earnings of operatives would be equitable during the period when they were temporarily working on hourly rates.

The pay which the foreman of the milling department had to determine was for the three operatives of the new milling machines. These machines replaced old equipment which the men had formerly operated and necessitated the operatives learning a new job if they were to remain on the company's payroll. The old machines had been discontinued because they had become so costly to repair and maintain that it no longer was economical to operate them.

The foreman of the milling department believed the new machines would reduce maintenance charges; would enable operatives to turn out products of better quality, in greater number of units per hour, and with less effort. He was of the opinion that if he set a temporary hourly rate at $2.50 while the machines were being broken in, the three workers might demand that this rate be used as a basis for computing piecework earnings once normal output had been determined. On this basis and with the usual 10 per cent increase in output when jobs were placed on a piece-rate basis, the operatives' earnings on the job would be unreasonably high as compared with the job value of $2.30 an hour. Under such circumstances a "loose price" would result, that is, earnings of the three operatives of the new milling machines would be greater than earnings of other employees, not because of the operatives' special ability and effort but because the piece rate was incorrectly set.

If a temporary wage rate were set at $2.50 an hour and the piece rate was based upon the job value of $2.30 an hour, the foreman feared that the operatives might think the company was arbitrarily holding down piece rates in order to restrict their earnings. On the other hand, if the temporary wage rate was set at $2.30 an hour, the men would earn 20 cents less an hour than they formerly had earned, and this reduction in earnings would come about through no fault of their own. The foreman believed that once the jobs were placed on new piece rates, however, earnings of operatives would amount to $2.50 an hour or more even if the $2.30 job value were used as a base.

Because of the difficulties which might arise in this situation, the foreman considered the alternative of setting temporary estimated piece rates for work done on the new machines. If this were done, the three workers would be guaranteed minimum earnings equivalent to the $2.30 per hour base rate on the job. The temporary piece rates would be discontinued as soon as permanent piece rates could be set.

The three operatives in question were known to be cooperative and loyal employees who had been with the company 10 to 15 years.

What should the foreman do?

PROBLEM 39 LAWRENCE DRUG COMPANY (B)

Among the operations involved in the manufacture of pharmaceutical products by the Lawrence Drug Company were the filling and sealing of ampules. These operations were performed by women working in teams of two, one filling the ampules and the other sealing them. There were 20 of these teams. The company instituted a bonus system which provided that 25 cents be paid to each member of a team for every 1,000 ampules which the team filled and sealed. This bonus payment was in addition to the operative's basic wage. Under the bonus plan the production of most teams jumped from 4,000 to 9,000 ampules a day while the percentage of rejects remained approximately the same. Shortly after the system was inaugurated, however, the plant manager limited daily production of each team to 7,000 ampules a day.

The filling and sealing operations were essentially simple. One operative placed the open ampule in the filling unit, pressed a valve which released the proper amount of fluid into the ampule, and then placed the ampule in a rack. The second operative removed the filled ampule from the rack, held the open end in a flame until the glass reached its fusing temperature, sealed the open end with tweezers, and then placed the sealed ampule in a box for packing and shipment. In order to maintain quality standards, the company found it necessary to require that all ampules be sealed shortly after they were filled. No ampules were permitted to remain unsealed overnight.

The basic wage of the filling operative was $44 a week, $2 less than that of the sealing operative. The filling operative could normally fill ampules 20 per cent faster than the sealing operative could seal them. The fusing speed of the glass fluctuated, since the weight of the glass and the diameter of the opening varied even in ampules of the same type. Therefore the sealing operative was always behind the filling operative; the amount of lag varied because of fluctuations in the time required to seal ampules.

When the bonus system was inaugurated, the plant manager noticed that the filling and sealing operatives cooperated to equalize the speed with which they performed their respective operations. The filling operative arranged the filled ampules so that the sealing operative could reach them without looking up from her work. The sealing operative thereby was able to concentrate a greater portion of her time on the sealing operation. Often she worked two or three hours without any interruption. At frequent intervals the filling operative also reported to the sealing operative the number of ampules filled so far that day as indicated by a counter on the filling machine.

Shortly after most teams had reached an output of 9,000 ampules a day, one of the sealing operatives showed signs of extreme nervousness. One day she was found in the ladies' dressing room completely upset. Soon other sealing operatives were similarly affected. The plant manager, on discovering the situation, gave each sealing operative a few days' vacation with pay. After an investigation of their job he decided to limit output of each filling and sealing team to 7,000 units daily. Under this arrangement all signs of nervousness on the part of the sealing operatives disappeared. Most teams completed their 7,000 units one-half hour before closing time. Although the operatives were then free to go home, they usually stayed at their benches where they talked or read, or they went to the company's recreation room where facilities for indoor games were available. The plant manager believed that the operatives were satisfied with the new arrangement, although their daily earnings were less than they had been when they were producing up to 9,000 units.

Be prepared to discuss the soundness of the management's actions.

16
WAGE DETERMINATION

THE BRIGHTVALE COMPANY

1. AN EXAMPLE OF UNION-MANAGEMENT COOPERATION IN SETTING WAGE RATES

The Brightvale Company made valves and allied fittings for the plumbing trade. A few months after the company signed a contract with a CIO affiliated union, a large number of wage grievances were brought to the attention of the management by union representatives. Study of these complaints indicated that the company's wage scale needed thorough revision, and the management arranged with the union to study all jobs and to set new wage rates wherever the study indicated that change was needed.

2. NATURE OF WAGE DETERMINATION

There is nothing remotely resembling a formula that will tell precisely how much a worker should receive for performing a specific task or working for a specific period such as an hour or a day. It is possible to indicate rather exactly what influences must be taken into consideration in setting a wage rate, whether it is a rate per unit of output such as a piece rate or a unit of time such as an hourly rate.[1] The quantitative expression of the values of these influences cannot be determined with anything like mathematical, engineering, or scientific exactness. In every case a substantial element of human judgment is required.

There are three kinds of major considerations that are important in setting a piece rate. The three factors that are important piece-rate ingredients are the time required to do the task; the job content, the things required of the worker in the performance of the task; and a host of related influences, most of them external to the job itself. These latter include such commonplace notions as the supply of and demand for workers capable of performing the work, organized pressures such as state and Federal laws, union demands and regulations, company wage policies, changes in the cost of living, current profits of industry, and the like.

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[1] For the purposes of this discussion, the piece rate will be used as typical of productivity rates and the hourly rate as representative of time rates.

3. TIME AS A WAGE ELEMENT

The time actually being taken to do a task can often be measured with considerable accuracy. To determine how much time it should take to do the job is a quite different problem that calls for the best of human judgment. Judgment considerations of major influence include the following: the skill of the worker observed doing the task relative to other workers of more or less ability who may do the job, the speed at which the man was working at the time he was observed, the effects of fatigue both physical and mental on the worker's production proficiency, the extent to which workers will be interrupted in the performance of the task, the need for and the results of worker training in a relatively easier way of doing the work, and the desire or lack of desire of the observed worker to attain a reasonable rate of output. None of these things can be measured exactly. However, careful adjustment of observed times, if all necessary modifications are considered, can give a reasonably reliable figure for the time it normally should take to do a task.

4. JOB CONTENT AS A WAGE FACTOR

Clearly, jobs differ greatly from one another in the ability required to perform them. This difference will be very influential in determining how much should be paid for the performance of the task. Analysis of the work involved in setting up and adjusting a screw machine so that it will turn out hundreds or thousands of duplicate pieces automatically will show that it is a vastly different task from the job of keeping the machine supplied with the necessary raw material and removing the finished parts that result from operation. The former is a highly skilled task that can be performed well only by a man who has had years of training and experience. The latter job calls for almost no training and can be performed by any reasonably strong person after a few minutes of instruction. Clearly the nature of the setup job is such that we should expect to pay a relatively high hourly rate for it in contrast to the hourly rate of the unskilled "operator" of the machine after it has been set up.

Job content, the nature of a job, can be accurately determined by an experienced analytical observer and can be set down in writing. To evaluate the relative "worth" of the content of two or more jobs cannot be done with an accuracy as great as is possible in determining the time it should take to do the job. Skill required to do a specific job, responsibility inherent in the job, physical drain of the job, and other common job characteristics are so intangible as to be difficult of measurement. However, methodical attempts at job content analysis usually will give more satisfactory comparative results than will reliance on general information or the foreman's offhand knowledge of the job. Such systematic analysis of job content requirements has become common in industry and is useful just so long as it is recognized that no index of relative job content can be determined with complete scientific accuracy.

5. RELATED INFLUENCES, THE THIRD TYPE OF WAGE FACTOR

The third type of wage consideration, related influences, is even less subject to measurement than is the time required to do the job or the nature of the job itself. The so-called "going rate" in the community is commonly taken as an index of the impact of supply and demand on each other. The validity of this assumption can be challenged, but inasmuch as the going rate concept is a useful one, we shall not concern ourselves with the question of the exact extent to which it is an accurate measure of supply-and-demand influences. The going rate itself is not easy to determine. But again let us accept the notion that often a representative figure is obtainable.

Such influences as minimum wage laws are more readily determinable. Union pressures and cost of living influences are matters of negotiation. Company wage policy as a wage determinant influence is a problem of definition and interpretation. When a company executive explains that his concern has a policy of paying the going rate or better, it is necessary to convert this generalization to something much more specific. Other influences resemble more or less closely some one of the foregoing. It is obvious that matters such as these are important considerations when it comes to fixing a wage rate. It is also clear that they do not lend themselves readily to measurement. In many cases quantitative expression is even more difficult than would appear on the surface.

This third class of wage determinant can be the most difficult of all when it comes to taking executive action. To understand and properly attend to these influences requires much thought and discrimination. Here they are treated only in superficial fashion, the objective being to make clear the nature of the problem of setting wage rates.

To summarize, a piece rate is an expression of a three-part complex:

time, job content, and related influence. None of these is completely subject to objective measurement. Systematic analysis pointed toward measurement is beneficial and should be a procedure of common practice.

6. COMPARISON OF THE HOURLY AND PIECE-RATE PROBLEMS

The setting of an hourly rate involves two of the three types of influence just summarized. The time factor is omitted as the basic assumption of the hourly rate is that management assumes the responsibility for the worker's proper use of his time while he is on the job. Thus the hourly rate is the result of combining job content considerations with all the related influences of the third class.

Actually an acceptable piece rate assumes the predetermination of an hourly rate for the task. In part there is a mathematical relationship between the two. Assume that a job content analysis and appraisal of all related factors have resulted in an hourly rate of $1.80 for a specific job. Assume also that time study shows that a normal hourly output for the job is 30 pieces. On this job the wage payment per piece should be 6 cents ($1.80 divided by 30). This relationship is sound and basically it holds. Not infrequently, however, certain other considerations enter the picture. Situations such as the guarantee to the worker of a minimum hourly take-home pay and the desire to make the piece rate serve as an incentive to a high rate of output frequently will cause departure from the simple mathematical relationship of the time standard to the basic hourly rate as it was just illustrated. Whatever the practice in relating the standard time for the job to the hourly base rate, the function of each is the same. Time standards are units of time; time study in itself never produces dollar values. Job content when combined with related influences will produce a dollar value per hour or other time unit. To get dollar values per piece produced or operation completed necessitates relating the two: the standard time per piece and the dollar value per unit of time.

7. MAGNITUDE OF THE BRIGHTVALE COMPANY UNDERTAKING

When executives of the Brightvale Company agreed with union representatives to a complete overhauling of the wage rates paid for the 400 or more jobs performed by its workers, they recognized that they were undertaking no small task. They realized that a result satisfactory to workers and management alike would require restudying most jobs to set new time standards, analyzing all jobs and evaluating their content in terms of a common standard, and finally negotiating with the union the base rates for each job studied. Demand for the company's products was at an all-time high point, and the executives were devoting their entire energies to increasing production to meet this demand. The proposed study would call for steady work by a group of capable technicians for at least 12 months. The company had a small efficient time-study department but had no experience in formal job rating. It was decided that in the light of these considerations it would be desirable to employ a firm of management consultants to do the work, and to this the union agreed.

8. COMPANY-UNION RELATIONSHIPS

Many of the company's 1,200 employees were either highly skilled or semiskilled. They included foundry workers, machine shop workers, assemblers, and maintenance workers. Although the company's experience with a union was brief, its relations with the workers and their union representatives thus far had been excellent. This friendly relationship was the result of a constructive attitude taken by the company executives. While the plant manager had regretted that the union had established itself in the company, he accepted the situation and made every effort to work with it. For months he had been devoting a large portion of his time to training his foremen and supervisors in ways of working with the union. He was sure that good union-management relations could be had if his foremen and supervisors understood the importance of day-to-day working together and knew how to conduct themselves to this end in their daily operating contacts with the workmen and their representatives. That he had made good progress with this program was shown by the way in which the union shop stewards were bringing wage inequalities to the attention of the foremen. The union stewards were aggressive in this work and were insistent that management take action. In every instance, however, they had gone to the appropriate foreman rather than directly to the plant manager and had shown understanding of the management's problem.

9. THE MANAGEMENT'S APPROACH TO THE WAGE GRIEVANCE PROBLEM

When investigation of the cases of improper wage rates began to indicate that the company's wage structure as a whole was at fault, the management called in the union representatives and explained the situation frankly. After several meetings the union agreed to a long-range program of complete resetting of standards and rates and in return were assured by the management that the union would be represented throughout the entire process.

Shortly thereafter the local president of the union gave the production manager the names of three of the company's employees with the request that they represent the union in the development and carrying out of the program. All three men had been employed by the company for some time and were known by the management as good reliable workers. One of these men worked in the foundry, one in the machine shop, and one in the assembly division. The management accepted the union's request that the machine shop representative should give his full time to the wage program and that the others should be available whenever required, particularly whenever work was being carried on in either of the departments they represented.

The company then assigned its chief industrial engineer to be responsible for the carrying out of the program. The chief engineer immediately requested the union committee to arrange to have two union representatives assigned to the time-study department for training in time and motion study work at the company's expense. This was done. The management then asked the three-man union committee to work with it in the selection of an engineering firm to carry out the work.

After considerable negotiation the union and the management selected the White Management Consultants for the job, and a "task force" consisting of the three union representatives, two men from the consulting firm, and the company's chief industrial engineer went to work.

At the start it was agreed that the program would cover three things: setting of time standards for all jobs in the plant, evaluation of all jobs in terms of their content, setting new piece rates for all jobs on piece rates and new hourly rates for all other jobs. It was agreed that the new job standards would be set by company time-study engineers and the newly trained union time-study men working jointly under the supervision of one of the industrial consultants. The other industrial consultant was to head a group consisting of the union representative of the machine shop and either the foundry or assembly division representative plus two men assigned from the company's industrial engineering department. This group would analyze all jobs and evaluate them, using a procedure that the management consulting firm recommended as having produced satisfactory results for a number of its clients.

Both of the industrial consultants were to be responsible to the company's industrial engineer who had been given responsibility for the entire program. He was to be responsible for combining the results of all studies. He and the plant manager would negotiate with a union committee to establish new piece or hourly rates on all jobs.

The management believed that bringing the union so completely into the picture throughout the study would tend to make for union acceptance of the resulting changes. The union was confident that by being so represented it could protect the interests of its members throughout. The White consulting firm had been selected from several applicants because it had a record of successful experience in cooperative union-management working out of such programs. Both the union committee and the management were impressed by the consultant's statement that his concern would be unwilling to accept the assignment on any other basis.

10. PROGRESS OF THE TIME-STUDY PROGRAM

From the beginning the study progressed satisfactorily. At first the work of the time-study group was slow. There was some disagreement between the union and the management time-study men as to suitable allowances for rest, interruption, worker speed, worker proficiency, and the like. However, the consultant in charge of the work insisted that the time-study men work out these differences themselves. They soon learned that by consulting with the workers on the job and the foreman in charge they could work out mutually satisfactory standards. This result was due in part to the fact that the time-study men did not concern themselves with wage rates; their responsibility ended once they obtained union and management acceptance of a standard time for the performance of a task. The time-study men worked in pairs, a union man and a company man. As soon as they agreed on a standard for a job, they reported the standard time for the task to the company's chief industrial engineer. He submitted the standard to the plant manager and to the union president. Usually after going over the work of the time-study men these three men would officially accept the standard. Occasionally it was necessary to bring in the two men who had set the standard for an explanation when the new standard differed radically from the one it was to replace. By getting official acceptance of a new standard as soon as it was worked out both the management and the union early gained confidence in the program. This served to speed up the progress of the work.

11. THE WORK OF THE JOB RATING GROUP

The steps followed by the job evaluation group consisted of the following:

1. Getting a written description of every job in the plant
2. Rating each job according to the procedure provided by the consulting firm
3. Ranking the jobs as a check against the second step
4. Plotting the jobs on a scatter chart and drawing a wage curve

12. JOB DESCRIPTIONS

Each job description was prepared by a union representative and a company man working together. They observed the job carefully: what the worker did; what tools and machines he used; what accuracy the work called for; the worker's responsibility for materials and for any helpers he directed; his responsibility for the safety of himself, his helpers, and for any others; the conditions under which the job was performed, such as temperature, dirt, fumes, etc. They talked with the worker and his foreman to learn to what extent the job involved planning by the worker, how much physical effort was involved, how constantly physical and mental effort had to be applied in performing the work.

From the information thus obtained the investigators wrote a description of the job. They were careful to make it cover all aspects of the task, to make it clear and as simple as possible. As soon as a job description was written, the investigators submitted it to the worker or workers who performed the task. If they approved the description, they signed their names to it. If they suggested changes, the description was rewritten until everyone concerned approved. This procedure was followed for all jobs in the plant.

13. RESULTS OF WRITING JOB DESCRIPTIONS

The job descriptions were completed in about three months. One result was the reduction of the number of jobs from 412 to 260. Many jobs were duplicated in different parts of the plant. In the past this duplication had not been recognized although the management knew that some duplication existed. Each of the 412 tasks had been treated as a different job, and wage rates had been set on each. The rates were not always the same when the tasks were identical. When the job descriptions revealed that actually there were only 260 different jobs, one cause of unsatisfactory wage rates at once became apparent. Both union and management were satisfied that one major source of trouble was located.

14. RATING THE JOBS FROM THE JOB DESCRIPTIONS

The next task undertaken by the job evaluation group was to rate the jobs, using the written job descriptions as a basis. Six job characteristics (factors) were used in rating each job. Following is a list of these factors and the maximum values that were allowable for each.

Skill—dexterity—experience required	300
Responsibility involved	200
Practical knowledge required	80
Mental effort	100
Physical effort	60
Working conditions	60

The job evaluation group first rated each of the 260 jobs for the relative skill, dexterity, and experience required for satisfactory performance on the job. The highest rating given any job for this factor was 300 and the lowest was 60. The group then rated the 260 jobs for responsibility involved in the performance of the job. Here the highest rating was 200 and the lowest 20. In like manner the 260 jobs were successively rated for each of the remaining four factors. The raters worked together as a group in making these ratings. Occasional disagreements were settled by observing the job again and talking the problem out with the workers and the foremen.

The next step was to total the six factor values for each job. This resulted in a total rating for the highest rated job of 510 points and a rating for the lowest rated job of 205 points. The total number of different ratings given the 260 jobs was 64.

15. CHECKING THE RESULTS OF JOB RATING

To get an over-all check on these ratings, the group arranged the 260 jobs in a rank list from highest rating to lowest rating. Examination of this rank list revealed three jobs that seemed to be out of line on the basis of the ratings. These jobs were restudied, starting afresh with the preparation of new job descriptions and rerating of the jobs on the basis of the new descriptions. It was found that one of the original job descriptions was faulty and that when this job was evaluated on the basis of the corrected description it fell into its proper place in the rank list. No errors could be found in the descriptions or evaluations of the other two jobs, and the group concluded that the original ratings were correct and should stand.

16. CONVERTING THE POINT RATINGS TO DOLLAR VALUES

The union and the management had agreed that after the job ratings had been established they were to be converted to dollar values according to the procedure that had been used in the past by the consultants. Six jobs that rated from low to high in the rating scale were selected as the basis for setting a wage curve. These were jobs on which everyone agreed that the present hourly or base rates were correct. This conclusion was checked carefully by going to a number of other employers in the area and obtaining the rates they were paying for jobs which investigation showed to be similar to the six jobs as they were performed at the Brightvale Company plant. These rates were further checked by comparing them with rates paid for the same jobs by competitors of the Brightvale Company that were located in other though similar industrial areas. The dollar rates for the six base jobs were established in this way. The point and dollar values of the six jobs were then plotted on a chart, with the result shown in Exhibit 1.

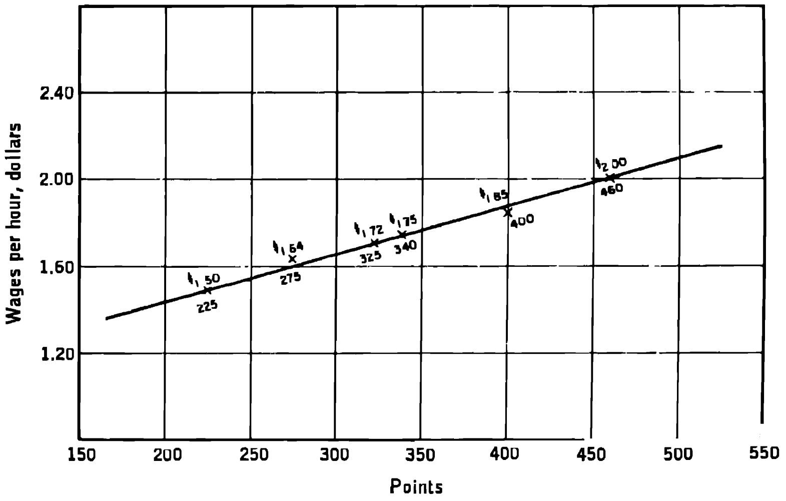

Exhibit 1. The Brightvale Company. Wage Curve.

It was found that a straight line could be drawn that would pass through four of the six plotted points and that the other two points were practically on this line. It was agreed that this line was to be the wage curve for establishing rates for all 260 jobs. Theoretically the hourly or base rate for every job could be determined by tracing the point value of the job up to the wage curve and reading the dollar value of that point in the line from the wage scale at the left.

17. NEGOTIATING THE WAGE RATES

Originally it had been agreed that the dollar rates for all jobs were to be negotiated. In preparing for this negotiation a chart was made up similar to that in Exhibit 1 on which were plotted all 260 jobs. This chart then showed what the rate on each job "should be" as compared with what the company was actually paying. The first agreement reached in the wage negotiation was that all existing rates that were below the evaluated wage curve were to be brought up to the line. Rates that were above this wage curve were then divided into two classes: those which were not more than 8 per cent above the line and about a dozen rates that ranged from 12 to 18 per cent above the line. It was agreed that when the existing rate was not more than 8 per cent above the evaluated wage line no change would be made in the rate. However, workers on these jobs would be notified that in event of a general wage increase their rates would not be changed until such time as the general wage level increased by more than 8 per cent.

The rates that were 12 to 18 per cent above the wage line were studied individually. It was finally agreed that four of these rates should stand because they conformed to rates then being paid generally in the community for similar work. No such justification was found for the other rates in this group, and after long and somewhat heated discussion it was agreed that these rates should be reduced to a figure 8 per cent above the rate as shown by the evaluated wage curve and should remain at that point until such time as general wage increases exceeded 8 per cent.

18. FUTURE RATE CHANGES

It was further agreed that in the future there would be no individual rate changes except as (1) the job content changed and (2) the management requested the union to allow an individual rate increase when there was no change in the job content. This latter provision was designed to allow the management to meet possible competition for workers under unusual community conditions of supply and demand. Apart from these two exceptions all future wage changes were limited to general wage level changes to be negotiated by the union and the management according to the provisions of the union contract. Four weeks of negotiation were required to work out the foregoing negotiation after the job ratings were completed.

19. SETTING NEW PIECE RATES

New piece rates for jobs on piece rate were to be set from the new hourly rates. The number of pieces per hour as established by the new time studies would be divided into the new hourly rates to get the dollar value per piece produced. This meant that for piecework jobs the evaluated hourly rate would serve as the base rate.

20. RESULTS OF THE PROGRAM

The wage program was completed in 14 months. Both workers and management were satisfied that much had been accomplished. Systematic consideration had shown at what points rates were out of line with what they should be, and a regularized basis for dealing with future problems of the sort had been established. Management believed that the program had been well worth the cost. The immediate impact on the company's payroll was an increase of about 2.6 per cent. The management believed that this increase in cost was fully offset by the relief it gave management by freeing it from constant attention to wage grievances. It further believed that the experience of working cooperatively with the union on so knotty a problem had increased the understanding by each party of the other's problems and had advanced union-management relations very substantially. The experience convinced the company executives that good continuing relations with the union were possible, provided that management would take the initiative in developing and furthering the relationship. The president of the local union stated that in his opinion the experience was most valuable in consolidating the position of the union and in developing confidence on the part of union members in their own leaders and in management.

21. SUMMARY AND CONCLUSIONS

Operating Problems as the Basis for Union-Management Cooperation. Little need be said in appraisal of the experience of the Brightvale Company in handling its wage problem. That experience speaks for itself. In union-management relations there is no more pervasive or important problem than that of wage rates. The case demonstrates that a union and a management can work together to the benefit of both. It is clear that good results depend on the willingness of management to accept the responsibility for such cooperation and the ability of the business executives to provide leadership. The only procedural pattern that can be deduced from this experience is the wisdom of bringing the union into the action pattern completely. By so doing from the start, understanding is developed by both parties and acceptance of change becomes much easier.

It should not be inferred from the description given here of this company's experience that no difficulties were incurred. Disagreements were frequent, but the individuals involved soon learned to respect the opinions of all concerned and an open-minded give and take developed. At no time did the cooperative procedure threaten to break down. Much of the credit for this goes to company and union leaders alike. Not all business executives would have had the patience shown by the Brightvale Company men. Not all union leaders have either the wisdom or the ability necessary to handle their own constituencies under like conditions. Slowly much labor and management in this country are learning how to work together, and there is no basic reason why the industrial game cannot be played successfully under today's rules.

In some industries, however, there is a growing tendency for unions to resist cooperative procedures such as that described here. In refusing to participate in wage setting activities, union executives sometimes take the position that it is management's job to propose wage rates, hourly or productivity rates, and that the union then will examine the proposed rates and accept or reject them as they decide. It seems probable that the reasoning behind the taking of such a position is that cooperation is believed to weaken the union's bargaining power. Under the Brightvale procedure, power bargaining is restricted to those areas where such bargaining is most appropriate. Job content is a question of fact and is not something that is properly negotiable. The same is true of the observed times that represent the time actually taken by a worker to do a job. The mathematical relation between time standards and base rates is similar. Under the Brightvale procedure these facts were agreed upon by joint union-management groups and were taken as "givens" in the bargaining aspects of the procedure. In one sense this does restrict the final freedom of the union to accept or reject specific wage rates. Clearly the same restriction applies to the managers of the Brightvale Company. Except when one of the two parties believes it has greater bargaining power than the other and can to its advantage thereby force its will on the other does the "restricts bargaining" argument make much sense.

There is some probability that union rejection of cooperative activity stems from the fear that cooperation may increase worker loyalty to the company that employs them. Union officers often have told the workers they represent that their loyalty should be to their own organization, the union; by being loyal to the employer they are "selling themselves down the river." Success in influencing workers in this fashion certainly tends to increase the personal power of union officials. It is likewise clear that when union leaders take this position management's efforts to create a cooperative situation become very difficult, even futile. To the author, such a situation seems most deplorable.

Job Evaluation as a Management Technique. Just a word about the job rating procedure described in this case. Job evaluation is a most misunderstood technique. Job analysis reveals little except relative job content as it exists in a given plant. Like time study it never provides a wage rate or a dollar value for a job. Often management expects it to do so, and when undertaken with this expectancy it inevitably fails. Job content is one of two factors in the setting of hourly rates and one of three factors in the setting of piece rates or other types of productivity rates. Time study can help to determine how long it should take to do a given job. Job analysis is a useful way of determining job content and of comparing several jobs as to what is involved in their performance. Neither time study nor job analysis results in a dollar value. The third class of influence, that which includes such external factors as the going rate in the community and organized pressures such as union demands, is the third essential element in rate setting. When the nature of the wage setting process is understood and the limitations of contributing techniques are realized, the systematic "scientific" approach to a problem can give results much superior to reliance on such stand-bys as know-how, tradition, and straight pressure "bargaining." Intelligent negotiation becomes possible.

QUESTIONS

1. What is the difference between a piece rate and an hourly rate?
2. What types of factors must be taken into consideration in setting an hourly rate?

3. What types of factors must be taken into consideration in setting a piece rate?

4. What does time study contribute to the setting of a wage rate?

5. What does systematic job rating contribute to the setting of a wage rate?

6. How are piece rates and hourly rates related?

7. What are some of the considerations, other than time and job content, that are important in setting a wage rate? Why are they so very important?

8. If time study and job analysis are employed in setting a wage rate, why and how does negotiation become a step in wage rate setting?

9. The work of the job evaluation group of the Brightvale Company was divided into four steps. What were these steps? What purpose did each step serve?

10. Why was each job description signed by the worker and the foreman concerned?

11. What gains resulted from writing the job descriptions?

12. What were the six factors used in rating the jobs? Why were they given different maximum point values?

13. How were the job ratings checked?

14. How were job point values converted to dollar values? Why was it necessary to negotiate a reconciliation of the wage rates as given by the evaluation curve with the rates actually paid by the company?

15. Were the results of the wage negotiation sound?

16. How did the job evaluation procedure aid in the wage rate negotiations?

17. Why was the management willing to have its payroll increased 2.6 per cent?

18. What function is job evaluation designed to perform as a management technique?

19. Why do operating problems provide an excellent opportunity for developing good union-management relations?

20. Why did the executives of the Brightvale Company believe that it is management's responsibility to take the lead in furthering good union-management relations? Is this conclusion reasonable?

PROBLEM 40 FORBERG MANUFACTURING COMPANY

The time-study department of the Forberg Manufacturing Company, manufacturers of valves and fittings for plumbing-heating purposes, had prepared time studies and set piecework rates on most production jobs performed in the Forberg plant. By 1946, many of the time studies for jobs performed on standard valves and fittings had been in existence for almost 20 years. Most of the work in the plant was paid for on a piecework basis. The average plant-wide hourly base rate was \$1.13½. The average worker on a piecework basis received approximately 120 per cent of his hourly base rate for piecework. Time studies on "fin grinding" and "snagging" of standard valves and fittings had been in use at the Forberg plant since the late 1920's. These particular time studies resulted in the setting of standards that allowed fin grinders and snaggers, in spite of the fact that they were considered relatively unskilled laborers, to receive weekly take-home pay amounting to considerably more than the average plant worker's take-home pay. This condition was called to the attention of Mr. M. M. Palmer, assistant to the works manager, by the head of the time-study department shortly after Mr. Palmer started working at the Forberg plant in early 1946.

The Forberg company had built up a good name in the valve and fittings trade. It concentrated on the production of valves with pipe sizes ranging from ⅛ inch to 3 inches in diameter. In 1946, the company employed approximately 500 production workers and operated on a 40-hour work week.

In June, 1946, Mr. Palmer received a summary of the piecework hours and wages paid to the fin grinders and snaggers during May, 1946 (Exhibit 1). This summary was prepared by the head of the time-study department for Mr. Palmer's use. During the month of May, wages for the two fin grinders totaled more than \$300 each, while wages for the ten snaggers averaged almost \$250 each; five of the snaggers received more than \$275 each. These figures were compared with a monthly plant average amounting to approximately \$210 per production worker in May, 1946. On an hourly "daywork" basis, however, the top rate for fin grinders and snaggers was 93½ cents as compared with the average rate of \$1.13½ for all production workers.

Exhibit 1 Summary of Piecework Hours and Wages Paid to Fin Grinders May, 1946 (A Typical Month)

Employee and No	Operation	Wed 1	Thur 2	Fri 3	Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Mon 13	Tues 14	Wed 15
Fin grinder 410	Piecework hours Wages dollars	7 5* 14 15 *	7 4 15 55	6 2 16 35	6 3 16 01	7 7 15 59	5 7 16 74	7 1 15 87	4 5 12 62	6 8 17 11	5 8 † 14 97	0 Abs
Fin grinder 411	Piecework hours Wages dollars	7 7 11 10	6 2 15 80	4 9 12 85	5 1 11 72	7 0 16 73	7 5 17 97	6 4 15 32	6 5 15 36	0 Abs	6 6 12 08	6 7 16 00
Snagger 412	Piecework hours Wages dollars	6 1 13 92	6 9 12 58	7 7 12 44	7 1 14 19	7 3 12 67	7 7 13 43	7 0 13 71	7 7 12 81	7 7 12 19	7 7 13 61	7 7 13 09
Snagger 413	Piecework hours Wages dollars	4 2 11 58	DW † 7 85	3 6 8 71	DW 7 48	DW 7 48	DW 7 48	DW 7 48	1 6 7 23	1 5 8 70	4 7 11 24	1 1 † 11 29
Snagger 414	Piecework hours Wages dollars	3 6 10 65	7 7 11 41	7 7 11 67	7 7 11 16	7 7 13 11	7 7 10 09	7 3 12 97	7 4 10 92	7 7 12 39	7 7 11 89	7 7 9 53
Snagger 415	Piecework hours Wages dollars	6 7 11 81	6 6 12 87	7 7 11 39	7 7 12 81	4 8 12 48	6 2 12 78	6 3 11 94	7 7 15 08	7 7 12 67	7 7 13 51	7.7 12 81
Snagger 416	Piecework hours Wages dollars	DW † 9 79	6 9 10 96	DW † 9 78	DW † 9 79	DW † 9 79	DW 7 48	2 6 † 10 65	DW † 9 79	4 1 † 8 75	1 8 † 9 75	DW † 9 79
Snagger 417	Piecework hours Wages dollars	2 5 † 9 65	7 7 12 26	7 7 11 42	7 7 11 63	6 7 11 61	2 7 † 9 88	7 0 10 89	7 7 11 24	0 ‡ Abs	0 ‡ Abs	0 ‡ Abs
Snagger 418	Piecework hours Wages dollars	5 7 13 11	3 7 11 75	7 7 14 55	7 7 15 88	6 1 11 13	5 3 12 75	7 7 15 88	7 7 15 71	7 7 16 31	7 7 14 48	7 7 15 32
Snagger 419	Piecework hours Wages dollars	5 6 † 15 79	3 7 12 52	7 7 17 17	7 7 15 31	4 8 12 73	5 4 † 16 83	7 2 17 72	7 7 16 59	7 7 13 45	7 7 18 53	6 3 † 16 18
Snagger 420	Piecework hours Wages dollars	4 6 9 74	DW † 7 68	DW † 8 54	3 7 10 00	DW 7 16	DW 7 16	DW 7 16	DW 7 16	DW 7 16	DW 7 16	0 Abs
Snagger 421	Piecework hours Wages dollars	4 5 † 15 00	3 1 11 29	6 1 16 08	6 6 12 87	DW 7 48	DW 7 48	6 9 13 51	4 4 † 14 53	2 4 † 13 19	7 7 14 97	4 5 † 15 00

* Example showing method of figuring daily wage (employee 410)

7 5 Piecework hours (rate × number of pieces) = $13 68

0 5 Daywork hours × $0 935 (daywork rate) = 0 47

(including 0 3 hour cleanup and 0 2 hour daywork)

8 0 hours Total wage for May 1 = $14 15

† Indicates man was on retainer during a portion of the day when he was not on piecework or straight daywork

and Snaggers

Thur 16	Fri 17	Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Mon 27	Tues 28	Wed 29	Fri 31	Total piece-work hours	Total wages for May 1946	Number days absent in May
6 7 16 27	5 3 15 00	5 3 14 43	7 1 17 33	4 9 † 17 44	4 7 12 57	7 1 15 71	6 0 14 19	5 6 † 14 74	5 7 † 17 00	7 3 14 39	130 7	$ 324 03	1
6 3 14 53	4 9 12 71	7 5 15 23	6 5 16 06	7 0 14 95	6 5 14 81	6 9 15 51	6 9 14 67	6 6 15 80	6 7 16 95	6 7 14 51	137 1	310 66	1
7 7 11 94	7 4 12 97	7 7 11 73	7 1 12 60	6 6 † 13 62	7 7 11 42	7 7 13 59	7 7 11 40	7 7 13 51	7 7 13 95	6 4 11 22	162 0	292 64	0
2 5 † 10 77	1 1 † 10 09	4 9 † 11 76	3 3 † 9 33	5 3 11 33	DW † 7 85	1 9 † 8 19	2 3 † 10 73	4 8 † 11 53	2 0 † 9 15	DW † 10 62	44 8	207 87	0
6 1 8 32	7 7 9 77	7 7 10 90	6 3 10 33	7 7 11 04	7 7 9 05	7 7 12 55	6 7 10 23	6 3 † 10 86	7 7 11 08	6 2 † 11 84	157 7	241 66	0
7 7 12 86	7 7 11 99	7 7 11 70	7 7 13 11	7 7 12 89	7 7 12 70	7 7 12 84	7 7 11 19	7 7 14 16	7 7 12 40	6 8 12 96	160 6	278 95	0
DW † 9 79	DW † 9 27	1 8 † 9 39	DW † 9 79	DW † 9 79	DW † 8 58	1 8 † 9 51	DW † 9 79	DW † 9 70	DW † 9 79	4 2 † 8 69	23 2	210 50	0
0 ‡ Abs	0 ‡ Abs	7 4 10 50	6 1 † 10 36	7 7 9 85	7 7 11 44	7 1 11 17	7 1 12 27	7 7 10 41	7 7 11 17	7 4 † 12 90	115 6	188 65	5
7 7 15 91	5 1 11 03	7 6 14 87	6 9 † 14 38	5 9 12 00	7 7 14 68	5 4 † 12 56	0 Abs	7 7 15 18	7 7 13 53	7 7 14 47	144 1	295 48	1
7 7 14 08	7 7 16 75	7 7 13 11	7 3 17 03	4 4 † 13 44	7 7 16 60	7 2 15 70	7 7 12 47	0 Abs	0 Abs	7 7 11 58	136 6	303 58	2
DW 7 16	3 0 8 80	1 0 7 88	DW 7 16	DW 7 16	4 9 9 61	DW 7 16	2 7 9 70	5 4 10 62	5 3 11 99	0 Abs	30 6	166 16	2
6 1 † 13 40	7 5 13 91	7 7 14 48	7 3 † 13 99	3 3 † 13 06	4 6 † 18 11	5 4 † 15 00	5 1 15 01	7 7 11 88	6 8 † 17 09	6 4 11 56	114 1	299 78	0
											1 357 1	$3 109 96	12

Retainers were paid for certain special jobs performed on a daywork basis but requiring some special work A retainer generally amounted to payment of an hourly rate somewhat above the worker's base hourly rate

‡ Vacation

Note 0 3 hour per day per employee was allowed for cleanup in the fin grinding and snagging department and was paid for on a daywork basis regardless of whether employee was working on a piecework basis or on daywork basis

Thus, even though fin grinders and snaggers were, according to the management, properly classified well below the plant average on an hourly rate basis, nevertheless, their average take-home pay was well above the plant average take-home pay.

In 1940, the Forberg workers had chosen the United Steel Workers of America (CIO) as their bargaining agent, no union having existed in the Forberg plant prior to that time. Relationships between the local union and the Forberg management were considered by the management to be good. A section of the union-company contract covered changes in standards or in rates. It stated, "Whenever a job has been time studied and there is no change in the method or procedure of performing the job, the rates established will not be changed except in those cases where there is a change in the general wage structure of the plant." Previous to 1940, company action regarding changes of standards or rates was governed by substantially the same policy. Hence, the time standards set for fin grinding and snagging of standard valves and fittings, although they were farther out of line than any other time standards in the plant, had never been changed.

Pay for work performed by fin grinders and snaggers was not all on a piecework basis. As a general rule, unusual and infrequent jobs were not time studied. Also, new jobs were not time studied until the usual production "shortruns" were completed. A retainer was paid to a worker who performed a special job on a daywork basis; this arrangement generally amounted to payment of an hourly rate somewhat above the worker's base hourly rate. Moreover, daywork performed by fin grinders and snaggers did not all consist of fin grinding or snagging operations. Thus, occasionally an employee might be asked by the foreman to clean an area or run an errand, for which he would be paid at his base hourly rate. The foreman in the grinding department determined the allocation of work. He attempted to rotate work among the employees; but generally the most difficult and lowest paying work was performed by the man with the least seniority. By the summer of 1946, all the fin grinders and snaggers had been working on their jobs for at least three years.

Fin grinding and snagging were two different grinding operations. The wage scales for the operations, however, were identical, ranging from 83½ to 93½ cents per hour. Also, both operations were performed on small, ordinary belt-driven grinding machines. Fin grinding was accomplished by using a narrow grinding wheel approximately ¼ inch wide; its purpose was to remove the "fin" left on valve-part castings or fitting castings at the location where pattern blocks joined together during the molding operations. The operator removed the fin by simply pressing the casting against the grinding wheel, following the contour of the casting. Little skill was required for such an operation. Snagging was accomplished by using a grinding wheel approximately 1½ to 2 inches wide; its purpose was to remove the "snag" or projection left on the "gate" or open ends of valve-part castings or fitting castings after molding operations. The operator removed the snag by simply pressing the casting against the grinding wheel, removing somewhat heavier metal than was removed by fin grinding. The snagging work was slightly heavier than the work performed by the fin grinders.

The amount of fin grinding and snagging on individual valve-part castings or fitting castings varied considerably. Sometimes castings required no fin grinding or snagging; it was the duty of the inspector in the grinding department prior to the fin grinding and snagging operations to segregate these castings from the castings requiring fin grinding and snagging. A fin grinder and snagger received credit for all valve parts and fittings that he handled, regardless of the amount of work actually required for each valve part or fitting. Theoretically, the time standards took variations in the amount of fin grinding and snagging into account by averaging out the variations.

Mr. Palmer stated that the company desired to pay employees in accordance with their abilities and efforts; therefore, from the company standpoint, the situation regarding pay for fin grinders and snaggers was considered highly unfair. Furthermore, excess labor costs resulting from such a situation had to be compensated for by reduced costs in some other area in order to maintain the profit margin desired by the company. Prices on valves and fittings were determined largely by competitive factors.

It was common knowledge among all employees that the fin grinders and snaggers received very high pay, even though the work did not require a great deal of skill or effort. Rates and amounts of pay were discussed freely among the employees. The attitude of the other employees toward the unbalanced situation and toward the fin grinders and snaggers seemed to be one of slight resentment. Other employees did not ordinarily begrudge a fellow worker's receiving good pay; they shrugged the situation off generally with a remark such as "What a hungry . . . that fellow is!" and wished perhaps that they were in the shoes of the fin grinders or snaggers.

What action should Mr. Palmer take?

PROBLEM 41 TAVA SHOE COMPANY (B)

The Tava Shoe Company manufactured men's high-quality shoes that retailed from $18 to $30 a pair. The company operated as a union shop. Over a 47-year period it had experienced no serious labor troubles. The company made a final change in the "cleaning" operation whereby one man was able to do with a machine the work formerly done by three men by hand. Originally all the work had been done by hand, but in the previous year a process was developed which allowed two-thirds of the work to be done by machine. Recently a change was made which enabled the machine to do the complete cleaning process. The final method had proved very satisfactory in operation, but the management had difficulty in reaching an agreement with the union concerning the piece rate to be paid the machine operative.

The Tava Shoe Company's plant was located in a small New England town in which the company was the only large employer. The Tava Shoe Company had been in existence for almost 50 years and during that time had continuously maintained friendly relations with the townspeople, most of whom had worked in the company's plant during some part of their lives. Normally the company employed 450 workers. Currently the company was operating at about 60 per cent of its capacity and was employing about 300 workers.

In 1897 an affiliate of the American Federation of Labor, the Boot and Shoe Workers Union, had organized a union in the company's plant. The company operated for 40 years as a union shop under a contract with this union which called for conciliation and arbitration if differences could not be settled in conferences between the management and labor. Until 1944 the Boot and Shoe Workers Union had maintained its position unchallenged. But in the following years the union had lost members, and there had developed a so-called "district union" which had acquired most of the former members of the Boot and Shoe Workers Union. This district union had no national affiliation, and its members were workers of shoe companies within, roughly, a 20-mile radius of the Tava Shoe Company's plant. The management believed that a few of the Tava company workers still retained membership in the old union.

The operating officials of the district union were elected by the workers of the plants which it represented in the district. These officials bargained directly with the managements of these plants on such matters as hours of work, wages, and working conditions.

The union officials appointed a chief steward for each plant to act as the official representative of the union at his plant. The chief steward was in each case an employee of the company at which he was the union representative. The function of the chief steward was to meet with dissatisfied workers, to act as their representative in discussing with the management any grievances that arose, to be the official bargaining agent in cases involving working conditions, and to report to the union officials. The chief steward, however, was not the bargaining agent for the union with the management on questions of wages and rates. On those matters the union officials themselves negotiated directly with the management of the plant. The district union paid the chief steward $3 for each hour that he spent on union duties when he would otherwise have been at his regular employment.

In each room or department in a plant the workers elected one of their number to act as room steward. It was the duty of the room steward to represent his fellow employees of the department in their relations with the chief steward. Room stewards served without additional compensation.

Whereas the Tava Shoe Company had dealt with only one representative of the Boot and Shoe Workers Union, it now became necessary for the management to come in contact not only with the officials of the district union but also with the chief steward and room stewards in its own plant. The company, however, as had been its custom, made every effort to cooperate with whatever union organization the men desired. Whenever a difference arose, the management attempted to make its position so sound that the union would perforce agree. As one company executive stated, before the management insisted upon its way, it made every effort to be absolutely sure that there was no possible chance that it could be mistaken. It disliked being forced to come out openly against a union claim or stand; it preferred, if possible, to obtain its end through its knowledge of human nature in general and of shoe workers in particular.

An example of the method employed by the management occurred when the men in one department had elected by popular vote a room steward whom the management came to consider unsatisfactory. The management believed that not only had this man shown himself to be undesirable from the company's standpoint but also he had given insufficient attention to the task of attending to the interests of his fellow employees. Nevertheless, the management had not openly opposed him but had permitted the situation to develop until it became unsatisfactory to the workers. Then one day when the general manager was passing through that department, he saw the room steward attempting to get a drink of water at the bubbler fountain. The general manager noticed that little or no water came forth. Upon investigation he found that the pipe was so old that it restricted a free flow of water. He thereupon called the room steward and, in a tone of voice audible to all the workers in the room, blamed him for failure to see to the comfort of his fellow workers. The general manager stated at that time that the room steward knew very well that the management was dissatisfied with such a situation and wished to have unsatisfactory working conditions reported to it at once. The general manager then hastened to have new pipes installed. The management later said that this incident was only one example of this man's failure to do an adequate job as the elected representative of his fellow employees. Shortly thereafter the workers gradually lost faith in the room steward and elected another man to this post.

When the established method of cleaning and finishing the manufactured shoes was changed, the management encountered a problem in setting piece rates which would be satisfactory to the union. Under the old method the work had been done in three operations. First, a man took a pair of shoes from a wheel-truck rack, examined them for blemishes, rubbed off with a brush stray bits of leather and any dust and dirt that might be on the shoes, and returned the shoes to the rack. Second, the worker applied a liquid cleaner which removed stains or other superficial blemishes. Third, the clean shoes were brushed and burnished. These operations might be done by three different workers under conditions of capacity production, but usually the work was done by a single hand "treer," a skilled workman.

Treeing had formerly been a highly skilled and important function in the manufacture of shoes. A treer examined the manufactured shoe while it was on the last, checked it for its fit and shape, trimmed off any rough edges that remained from cutting, examined the lining, and applied filler and surfacing material to the leather. After this treeing operation, the shoe was ready for cleaning and polishing.

Technological developments and improved methods of cutting, fitting, and assembling the shoe had, however, simplified the treer's job and made it less important. Modern leathers were ready for cleaning and polishing without the application of fillers and surfacing materials. Cutting and assembly blemishes were rare. Under these conditions the three operations involved in finishing shoes could have been done almost wholly by unskilled workers if the union would have permitted it. The union, however, insisted that the first of the three operations outlined above must be done by treers, although under conditions of capacity production the final two operations might be done by unskilled workers.

The new machine which the Tava Shoe Company had finally developed performed all three operations and did them, the management stated, more satisfactorily than hand labor. The machine had been manufactured for the Tava Shoe Company by the company from which it regularly leased much of its equipment. The Tava Shoe Company had sold to this company the rights to manufacture and sell the new machine. It was expected that this company would build and lease a large number of these machines in the near future.

The new machine consisted of a rapidly rotating friction brush onto which a fine nozzle sprayed a volatile cleaning fluid. All that the operative had to do was pick up a shoe, step on the pedal which controlled the spray mechanism on the machine, and hold the shoe against the burnishing brush. The brush deposited the proper amount of cleaner on the shoe, imparted the desired surface finish, cleaned the shoe thoroughly, and removed any excess dust and bits of leather that had accumulated from handling during the preceding hundred or more operations.

The machine was almost foolproof. If the heel of a shoe was thrust against the brush first, the burnishing brush would be rotating against the grain of the leather and would roughen the surface. The natural, easiest way of holding a shoe, however, was by the heel. So held, the shoe was almost sure to be thrust against the burnishing brush so the toe met the brush first; and the brush would properly burnish the shoe with the grain of the leather. Furthermore, it was not possible for the worker to hurt the shoe by applying an excessive amount of the liquid cleaner. Should he keep his foot on the control pedal too long, the heat generated by the rotating brush would sufficiently accelerate evaporation so that no damage would be done to the shoe.

The management believed that the job of operating the finishing machine was essentially unskilled, but acceded to the union's demand that the machine be operated by a skilled worker who had formerly been a treer. The management had the machine installed and began operation, paying the operative the union day rate. Throughout the following year the management attempted to place this man on a piece rate. The management stated that time and motion studies showed clearly that it would be possible to turn out 900 pairs of shoes a day on this machine without undue strain upon the worker. Although the management had no doubts about the accuracy of the studies, it was willing to base a piece rate upon a production standard of 600 pairs a day. Piece rates throughout the Tava plant were so set that a man who produced up to the established normal production would receive 15 per cent more than the accepted day rate for the job. The operative of the finishing machine reported to the shop steward that this operation was difficult and claimed that it was hard to produce 250 to 300 pairs a day. This operative happened to be room steward in this department, which employed about 20 workers. The management was convinced that the operative was soldiering on the job and could see no reason for production so much below the estimated normal, unless it be narrow selfishness and personal bias on the part of the operative.

At the rate at which this man was working, it was uneconomical to route all types of leather shoes over the machine. It was cheaper to use the old hand method on most shoes. Therefore, only certain types of leather which required abnormal amounts of cleaning and treatment were being cleaned and finished by machine.

The union had supported the employee in his contention, and the management had been unable to change the union's stand. Analysis of the operation, based on time and motion study, had not been convincing evidence to the union. Recognizing the difficulty of the problem, the general manager in December, 1947, was seeking some means of showing the union the fallacy of the worker's reasoning; he was convinced that, if he could accomplish his purpose, the union would be ready to accept the piece rates proposed by the management.

QUESTIONS

1. What do you think the general manager should do?
2. If the Tava Shoe Company had had a rate setting procedure similar to that the Brightvale Company worked out, what steps would have been taken to reach a solution to the Tava problem?

PROBLEM 42 ANTON ELECTRIC COMPANY (A)

The Anton Electric Company was considering revising its method of setting the piece rates that were used throughout the plant. In the past

the company had considered time study as too expensive. A new executive believed that time studies would improve the company's wage rates and proposed a method of setting job standards which he thought would not be excessively costly.

When Mr. J. J. Frisby took charge of the time- and motion-study work of the Anton Electric Company, he thought that a good proportion of the piece rates for the roughly 1,725 production and assembly operations of the company were either too high or too low and needed revising. None of these piece rates had been set from stop-watch studies; most of them were estimates. Mr. Frisby believed that all piece rates should be based on stop-watch time studies, with proper emphasis on methods analysis.

The Anton Electric Company was 20 years old. It manufactured electrical measuring instruments and special electrical devices for radio broadcasting companies, power plants, government technical bureaus, research organizations, colleges, and manufacturers of electrical equipment. Some of the units produced for electrical equipment manufacturers were built into the products sold by these manufacturers to the general public. All the company's products were noted for their high quality. Each was designed to meet the special requirements of customers. Most of the products had limited markets and were produced at infrequent intervals. For example, many instruments were designed exclusively for radio broadcasting stations to enable them to conform to rulings of the Federal Communications Commission. The market for any one of these instruments was limited to the number of commercial broadcasting stations in the United States. After the initial requirements of each station for a particular instrument were supplied, the instrument was produced only on the rare occasions when replacements were necessary or a new station was licensed.

The experiments and inventions of its engineering department enabled the company to introduce several new products each month. Some of these products had a large potential demand and were produced in considerable quantities; but when such items were copied by competitors who placed them on a mass production basis, the Anton Electric Company usually stopped making them. The company would not produce an item which required the purchase of special equipment to meet competitors' prices. It used exclusively either general-purpose equipment or equipment that was flexible in the making of electric items. The company depended upon the steady introduction of new items to maintain factory volume. No single item was allowed to provide more than 20 per cent of total factory output. Plant facilities were never expanded unless the management believed that the additional workers could, from the long-run viewpoint, be employed steadily.

All manufacturing employees of the Anton Electric Company, except testers and inspectors, were paid piece rates. Each worker was guaranteed a minimum hourly pay rate. These hourly rates for various types of work were set by the president, vice-president, and treasurer with the assistance and recommendations of supervisors. If a worker's piece-rate earnings on any job were less than his guaranteed hourly rate times the hours taken by him for the job, he was paid for the task at the hourly rate. Excess of hourly pay over piece-rate earnings on an assignment was not deducted from earnings on other tasks on which the worker's piece-rate earnings were in excess of his guaranteed hourly earnings.

In addition to receiving regular wages, all the company's employees shared in the company's profits. Profit sharing was made a permanent practice after eight distributions had been made in the preceding 10 years. All the company's stockholders were in the employ of the company. If, in the opinion of the directors, the earnings of the company exceeded the amount required to pay stockholders a dividend equal to normal interest, the excess was distributed in two annual payments on November 1 and May 1, as apportioned by the directors.

During the past five years for every dollar paid in dividends, 90 cents had been paid to employees. The employees' share was divided among all the employees in proportion to the contribution which the president, vice-president, and treasurer thought each employee made to the company's current success. These three officers independently rated every employee on the basis of the following: efficiency, amount of tardiness or lost time, opportunity for piecework, ability, and willingness to cooperate with others. Maximum numerical point values had been set for each of these qualities, and the three officers' ratings of the men were expressed in points which indicated the extent to which the individual was believed to approach the allowed maximum. The three independent ratings were averaged and multiplied by a factor which adjusted for variations in workers' pay rates. When an employee supervised the work of others, his rating was multiplied by a second factor. The employees' share of the year's earnings was then distributed among all workers in the ratio which the individual's point rating was to the total of all point ratings. The following examples illustrates how an individual's point rating was computed and his share of the profit determined:

Method of Computing an Employee's Share of the Bonus

John Doe was above the average in ability, accuracy, and capacity to do the work expected of him; his piece-rate earnings on a job were usually greater than his base rate of pay; he was a few minutes late once or twice each month; he was friendly and helpful to everyone, especially to new employees. For these qualifications he had been rated as follows:

Qualifications	Average of three officers' ratings	Highest possible rating
Efficiency....	35	40
Lost time....	10	15
Piecework....	5	10
Attitude.....	18	20
Total......	68	85

The multiplying factor for the $1.50 hourly rate was 3, which multiplied by 68 points' credit gave John Doe a total of 204 points. At the time this rating was made, $16,000 had been available as a bonus for employees, and on the basis of total points of all employees, one point was worth 44.4 cents. Therefore, John Doe's share had been $91 (204 × 44.4 cents).

Piece rates for the 1,725 current production and assembly operations had been set by Mr. Frisby's predecessor, who had estimated the time required to complete every operation by comparing it with similar work done by company employees in the past. He then had set a piece rate for the operation which he believed would enable the worker doing the job to earn somewhat more per hour than his guaranteed hourly rate. This piece rate remained in force for six months or more. After the part was produced for a period of time, the piece rate was revised to take into consideration the experience gained in performing the task. Each operation rate was usually readjusted every six months, and succeeding readjustments made the piece rates more accurate in terms of the time taken for the job and the hourly rates of the workers.

The former piece-rate setter stated that the rapid turnover in the company's product line made the need for setting piece rates continuous and that, if rates were set from stop-watch studies, the task of rate setting would be difficult and costly. He pointed out that most of the 850 items currently listed in the company's catalogue were new developments and were assembled from 7,500 different parts, of which only a small number were standard and were used in more than one item. He had believed it impossible to set more than a small percentage of the existing rates from time- and motion-study data.

Mr. Frisby had been a member of the company's cost accounting department before he took over the time-study work. He was convinced by his observation of cost variations that piece rates had not been accurately set, and he believed that only when piece rates were based on stop-watch studies would they be satisfactory. Mr. Frisby agreed with certain company executives that the rule-of-thumb methods employed in the past might have an undesirable effect on worker morale if allowed to continue indefinitely, even though the workers had not questioned rates and had never objected to rate changes. Because most items were manufactured only a few times, and even standard parts and items of fairly long life were produced in large lots at infrequent intervals to reduce setup expense, the worker usually had a newly determined or revised piece rate every time he was assigned a task.

Mr. Frisby made a careful study of the 1,725 different current operations and found that grouping essentially similar operations together resulted in only 80 distinct types of operations. For example, drilling on a drill press was one type of operation. All drilling operations consisted of the following consecutive steps: placing the piece in the jig, starting the spindle, bringing the drill in contact with the piece, feeding the drill into the work as it cut, raising the tool from the work, and removing the work from the jig. The time required to complete this cycle varied with the size of the drill, the depth of the cut, and the material being worked. Combinations of these variables made it necessary to set up a considerable number of drill-press-work piece rates, one for each combination.

Mr. Frisby proposed to make time studies of the component variables of drilling operations, rather than of various drilling operations as a whole. Once standard times were set for the components of the drilling cycle, and the effects on the components of variation in materials worked, diameter of drill, and depth of cut were determined, these data could be prepared in chart form. Time studies whenever a new part required a drilling operation would be unnecessary; analysis of the drawing of the new part would make it possible to build up, from the charts of standard variation factors, a time allowance for the required operation. This time allowance could be checked against past experience on that type of operation, and piece rates could then be set to reflect the results of stop-watch studies, past experience, and workers' hourly rates and earnings.

Building up standard tables for the 80 types of operations would take considerable time, but once a type had been studied and standards set, few additional studies of that type of operation would be needed. Mr. Frisby believed that one man could do this work, that an inexperienced clerk could learn to set time allowances from standard tables rapidly, and that there would be no increase in cost of setting piece rates. He believed that rates set in this way would be more accurate than those set by the old rule-of-thumb method.

QUESTIONS

1. What advantages, if any, would the proposed method of setting rates have over the practice being followed?
2. What, if any, disadvantages would there be?
3. If wage rates were based on the proposed method, would there be any effect on bonus payments? Please explain.
4. How, if at all, would change to the proposed method affect prices charged by the Anton Electric Company?

PROBLEM 43 NEW BOSTON DAIRY COMPANY

In January, 1962, the New Boston Dairy Company executives were considering a request of the company's employees that would completely change the method of compensating the company's workers. The unusual character of the proposal made the management uncertain as to what action it should take.

The New Boston Dairy Company manufactured ice cream which it sold to retailers throughout western Massachusetts. The company was one of the oldest in this industry in New England and was well known for the high quality of its products. Prices charged retailers were higher than those of other ice-cream producers, and consumers paid 10 cents to 20 cents more per quart than for other locally well-known brands. Company profits had fluctuated. During the 50 years of its existence the company had experienced a loss in 9 years.

The New Boston company had 492 nonsupervisory workers. This number included factory employees, office workers, and route salesmen. The latter drove the company's delivery trucks and sold its products to retailers on their routes. The company had two "general salesmen." These men were not deliverymen; they spent their entire time with the route salesmen helping them to open up new accounts and regain accounts which had been lost to competitors.

About four-fifths of the factory employees were paid piece rates. The other one-fifth were sweepers and cleaners, maintenance men, watchmen, and the like, who were paid on an hourly basis. Office workers were paid by the week. Route salesmen were paid by the week plus a commission that depended upon the volume of products each sold. The two general salesmen were paid weekly salaries. These methods of compensation had been in use by the company for many years. The management considered its employees to be "well paid."

There was some seasonal fluctuation in volume of sales. The increased summer demand was met by adding temporary workers, usually college and high-school people who wanted vacation employment. The sales force was not increased during these summer peaks. The route salesmen worked long hours, and those men most affected hired "helpers" to ride their routes with them. The route salesmen who used helpers paid the helpers themselves.

Management-worker relationships were friendly, and it had never been necessary to resort to the use of outside services to settle the occasional disagreements and grievances that arose. Although turnover of the work force had increased since the Second World War, company executives considered it to be no higher than was to be expected in a highly industrialized urban community.

Recently a group of five company employees including representatives of the plant, the office, and the sales force formally presented to the management a request that the methods of worker compensation be completely changed. Essentially the proposal consisted of three fundamentals. All permanent employees were to be paid annual salaries. Each week a worker would be paid one fifty-second of his annual pay. On the first of December each worker would be paid a bonus the amount of which would depend on the sales volume for the preceding 12-month period ending October 31.

The committee representing the employees had not worked out the plan in complete detail, but they were in agreement on many of its features. They proposed that for the coming year all workers on the payroll as of January 1 would receive a salary equal to their total earnings for the past year. The salary was to be paid in 52 weekly installments. The company's regular auditors would compute the total payrolls for the past five years and the total sales for the same period and would calculate the percentage which the payroll total was of the sales total. Company bookkeepers would apply this percentage to weekly sales during the year and segregate the resulting amounts in an account to be known as the "wages pool." Each week's payroll would be charged to this account. On December 1 the undistributed credit remaining in the wages pool would be distributed to employees on the payroll at that time as a bonus or carried forward into the following year as a credit in the wages-pool account. If on October 31 there was a debit balance in the wages-pool account, the result of salary withdrawals exceeding sales credits, the salaries of workers for the following year would be reduced by an amount sufficient to cover the deficit in the wages-pool account. Otherwise the total amount to be paid out as weekly salaries would be subject to negotiation by workers and management each year.

In connection with the desire for a new compensation plan the worker representatives made a further request. They asked that the determination of each worker's annual pay and share in the year-end bonus be turned over to a committee of workers to be elected each year by the employees. Acts of this committee would be subject to the limitations described in preceding paragraphs. They also asked that the time of adding temporary workers and the number of temporary workers to be added be determined by the same elected committee. Wages to be paid these temporary workers would be fixed by the management and would be a charge against the wages-pool account.

Another request was that no new permanent worker be added to the work force without the consent of the workers' committee. And finally they requested that no permanent worker be laid off as long as there were other permanent workers on the payroll. In the event of a reduction in volume of output sufficient to make possible any layoff of permanent workers, the work available would be shared equally among the permanent work force.

The worker representatives asked that the management appoint an equal number of representatives to work out details of this program with them. The management was unwilling immediately to participate in such a committee activity and asked that they be given several weeks in which to consider the proposal. The workers expressed entire satisfaction with this reply to their requests.

QUESTIONS

1. Should the executives of the New Boston Dairy Company undertake to work out the plan proposed by the employee representatives?
2. Be prepared to discuss any modifications you believe should be made.

PROBLEM 44 EMPRESS CLOCK COMPANY (B)

In 1961, executives of the Empress Clock Company of Sanville, Ohio, were considering installing an incentive wage system. Company executives estimated that the general efficiency level of the employees was about 50 per cent of what it should have been and believed that an incentive wage system might aid materially in raising the workers' output.

The Empress Clock Company, a small producer in the industry, was highly regarded for the quality and fine design of its clocks. The average selling price of these clocks, $100, was in keeping with the quality of the line. The company sold quality and made no attempt to compete with low-quality clock lines. High quality was emphasized throughout all production processes. Even the flat heads of the small screws that went into the clock movement were polished to a mirror finish, although polished screw heads had no direct relationship to the working accuracy of the clock movement and were not visible to the customers since the entire movement of a clock was enclosed in a case. This great emphasis on quality refinements was traditional with the company and distinguished it from companies manufacturing lower priced timepieces.

The manufacturing organization of the Empress Clock Company was simple and well adapted to the company's needs. The treasurer of the company was also the factory superintendent in charge of manufacturing operations. An industrial engineer, a chief engineer, a production manager, and a chief inspector assisted him. The industrial engineer was responsible for methods work, layout problems, and the setting of time standards. The chief engineer was in charge of product development and design activities; he adapted design changes to the company's operating facilities and determined the best process of manufacturing newly designed clocks. The production manager supervised production control work which included planning, scheduling, and inventory control. The chief inspector supervised all activities, including thorough checking of every clock for accuracy.

The operations involved in clock manufacture included turret lathe work on the clock cases, stamping and piercing the various plates that went into the clock movement, automatic screw machining of pinions and screws, cutting the teeth in clock wheels on hobbing machines, plating and buffing operations, and finally two major assembly operations. The first of these assembly operations was known as plate and train assembly. In this department component parts were assembled to the clock movement. In the finishing department, assembly of the movement was completed, the movement was assembled in the case, and the completed clock was adjusted and tested.

The company employed 175 operators in the various production departments. Ninety-two of these operators were girls who worked in the company's two assembly departments. Many of the employees had been with the company for more than five years. Company-employee relations were very cordial, and this spirit was carried outside the plant in the form of evening get-togethers of the workers. The treasurer took pride in the high quality of his employees, and he took pleasure in walking through the plant observing them at work. There had been two attempts at unionization by different labor organizations, but each of these failed to get the support of the workers.

All employees were paid hourly wages. The treasurer of the company stated that it was his long-run aim to pay a minimum wage of $2 an hour. He hoped to reach this point before other producers in the industry and the area. He believed that the only means feasible was to increase worker productivity sufficiently to enable the company to sell more clocks at a lower price, still maintaining quality. The treasurer was not certain of the length of time necessary to attain this objective, but he believed that worker output was not more than half what it might be, and he was hopeful that incentive wages might be helpful in achieving his goal.

The treasurer was not certain at the time whether the plant was ready for an incentive wage system, and he was also uncertain as to the type of wage incentive that would be most desirable. The services of a consultant were obtained to help answer these questions and to assist in establishing an incentive plan. The consultant acted solely in an advisory capacity and was not retained to stay with the company and work out the details of a new wage payment plan. He visited the plant once a week and discussed various problems, assisting the personnel concerned in thinking out the situation. He made only very broad recommendations, leaving details to be worked out by the operating executives.

The company executives decided that, before attempting to work out a wage incentive plan, they would devote some time to examining the production methods and the plant layout. The men immediately concerned with this problem were the industrial engineer,[2] an assistant who was a university graduate with experience in several large concerns, and, later, a girl who was trained to take time studies. The assistant industrial engineer left the company after six months since he was unable to adapt his experience with large companies to the Empress Clock Company's situation. The time-study girl who later joined the staff was trained by the industrial engineer. She had been a group leader in the finishing department and had been with the company for five years.

Following an initial examination of the company's situation, the management decided that the following steps would be necessary before the company could establish a successful wage incentive plan. First, the existing plant layout and methods would be analyzed in detail and improved wherever possible. Methods and procedures would be standardized. Simultaneously a training program would be established to familiarize foremen, group leaders, and operators with the company's objectives and how they were to be attained. Time studies of operations then would be taken, and standard job times would be established. After completion of the above steps, the problem of an incentive system would be considered again.

The industrial engineer immediately began to study the flow of work in the two assembly departments. Improved layouts were then made on paper; these were examined carefully and discussed thoroughly until highly efficient layouts were devised. The new layouts had to be put into effect without interrupting production. The work of actual change-over in each department was done so rapidly, however, that production delays were held to a bare minimum.

The entire interior of the assembly rooms was painted a soft green and white, which were the colors selected by the employees by vote. A fluorescent lighting system was installed which, with the freshly painted walls, resulted in bright, well-lighted work areas. Work tables were rearranged to meet the requirements of the newly planned flow of work. In addition, the work tables were lowered so that operators could sit and be more comfortable while at work. These layout changes made available much-needed additional space.

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[2] The industrial engineer had started working for the company as a day laborer in the shipping room. From this start he had made his way up through the other departments of the plant, had become a group leader and then a supervisor. During this time he had studied motion and time study, incentive wages, job evaluation, plant layout, and the like in a nearby university that had a night school program. His experience in the several plant departments was very useful to him in his work as chief industrial engineer.

All work methods were examined critically, the objective being to make each task easier to perform. An experimental room was set up with the girl, who later became the industrial engineer's assistant, acting as operator. Improved workplace layouts and work methods were tried out. This experimental work led to changes in methods that included new breakdowns of operations into more simple components, prepositioning of tools and materials, and changes in sequence of operation that gave a steadier flow of work.

After the workplace layouts were completed, the operators were trained to work efficiently, using the improved methods devised in the experimental workroom. The industrial engineer and his assistant demonstrated the proper motions and sequence of operations to the lead girls and the operators. After a lead girl became proficient at the workbench, it was her responsibility to coach the workers and further demonstrate the proper way of performing a job. The industrial engineer prepared charts showing left-hand and right-hand motions that assisted each lead girl in training the workers in her group.

A classroom training program for the workers and the foremen was undertaken at the same time that the methods work was being done. The industrial engineer stated that he hoped this program would encourage workers to accept the many changes being made in the shop through an understanding of the nature of the changes and why they were instituted. The industrial engineer developed another training program designed to increase the ability of the foremen to handle the workers and broaden the foremen's knowledge so that they would be better supervisors. The industrial engineer conducted the classes for the workers. There were six people in a class group, and each class group met 20 times for 45 minutes of instruction. Exhibit 1 is a reproduction of one of several graphs prepared by the industrial engineer to show the effect of this training program. The curve shows the daily production of one operator for the first 31 days she was on a new job after she had been thoroughly trained in the work. This was a new operation that had been worked out by careful methods study. Although the girl previously was well instructed in the performance of the work, her initial output was low and she made little progress until the thirteenth day. On the twelfth day she and five other workers attended the first meeting of one of the company's 20-

session training courses. Her performance for the following 19 days is shown on the chart. The curve of this girl's progress is typical of what happened to workers' output when they started the training program classes.

The industrial engineer was of the opinion that, as a result of the training program, many of the operators had become capable of taking time studies and that the program had influenced most of the workers to think constructively about the methods they used in their various tasks.

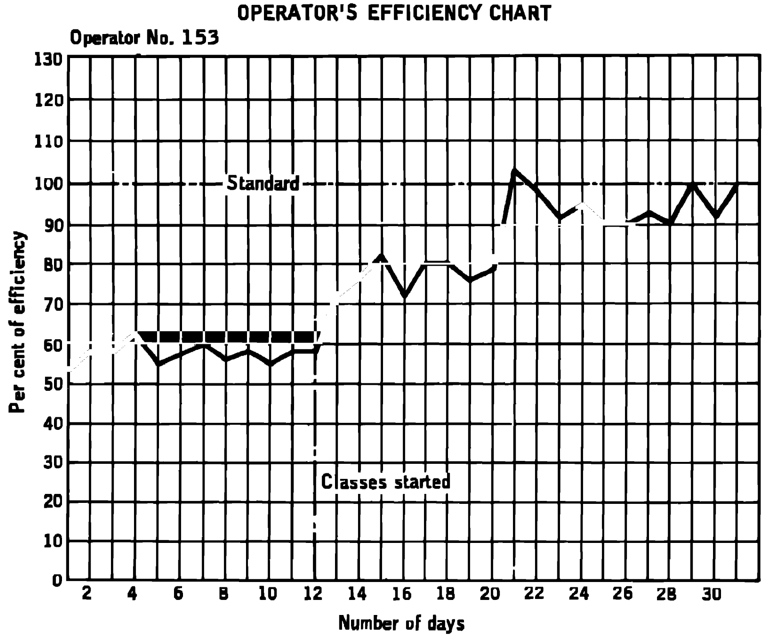


Exhibit 1. Empress Clock Company. Chart of Output of Operator 153 for 30 Days after She Had Been Trained on the Job.

In March, 1962, all jobs in two departments, the plate and train department and the finishing department, had been studied and a standard method of performing each job had been set. Workers had been taught the new methods, after which stop-watch time studies had been made. Standard task times in minutes per piece had been set from the time studies. Compilation of output figures for these two departments showed that the workers' average output had increased 72 per cent since the department layouts had been improved and the job methods had been changed. Measured against the time study standards that had been set for the jobs in these departments, the workers had been producing at the rate of 32 minutes of output per hour in 1961. In March of 1962, worker output, measured against the same standard, averaged 55 minutes of work per hour.

Company executives were pleased with the 72 per cent increase in output in the two assembly departments. They believed, however, that with the proper incentive wage plan the operators should produce 65 to 75 minutes of work per hour. They were not sure of this, nor were they certain as to the type of incentive system that would be most suitable for the company.

One plan they were considering consisted of setting a standard time for each unit of output and paying workers at an hourly rate for each job for the time value of all work produced. If the standard time for a job was 13 minutes and the hourly rate for the job was $1.50, a worker who produced 44 pieces in an 8-hour day would receive credit for 44 times 13 minutes, or 572 minutes of work. At $1.50 an hour the worker would receive $^{572}/_{60}$ times $1.50, or $14.30 for the day's work. The treasurer of the company was certain that he wanted to pay the workers full rate for every piece they produced. He was opposed to any "share the production" type of plan, such as those which paid the workers for less than 100 per cent of the work produced in excess of standard.

QUESTIONS

1. Should the Empress Clock Company install incentive wages in the two assembly departments?
2. In preparing for the installation of an incentive system, company executives had prepared a detailed step-by-step program of action to be taken. Outline this program.
3. Prepare a comparable step-by-step action program to be followed subsequent to the establishment of job standards in the two assembly departments.

17
PERSONNEL MANAGEMENT

JUTE BAG COMPANY (B)

1. NEED FOR PERSONNEL ORGANIZATION

The Jute Bag Company, an old, established producer of bags and bagging, experienced difficulties with its personnel. Labor productivity was declining, and an increasing feeling of hostility between workers and management was evident. The company had never established a separate organization for handling personnel activities. One of the vice-presidents recommended the adoption of a personnel program which was identical with one in operation in a well-known textile mill. Extended consideration of this proposal resulted in the employment of an experienced personnel director. Over a period of five years this man developed and put into operation a personnel program which proved successful.

2. GROWTH OF PERSONNEL MANAGEMENT

Personnel activities in industrial companies in the United States have expanded greatly during the past 25 years. Many firms that previously had no formal organization for handling these activities now have set up staff-type departments responsible for personnel work. Companies with personnel departments have extended the activities of these departments greatly. The personnel function has grown in stature; it is not unusual in large companies to find this work headed up by a vice-president. These developments are the result of much new state and Federal labor legislation, an increase in the strength of unions, the constant rise in wage rates, and an increased recognition by top management that good personnel management can enhance profits.

Some companies combine the function of dealing with unions and typical day-to-day personnel activities, such as hiring and training of workers, in a single department. There are various points at which it is difficult to separate these two types of problems. The handling of worker grievances according to a procedure set forth in a union contract is such a problem. Such interrelationship argues for combining the two activities in a single department.

In larger companies, union negotiations often are carried on in a department separate from the personnel department. When a company operates a number of plants, each under its own management, union relations for all plants are likely to be centralized in one company-wide industrial relations department. Each plant will have its own personnel department which confines itself to the daily operating problems of its own personnel. In this chapter we will focus on the work of the typical personnel department with only the minimum necessary concern with union contract negotiation and other essentially union-management problems.

3. OBJECTIVES OF PERSONNEL MANAGEMENT

Strictly speaking, the personnel department is a service organization; it should serve both the company's operating organization (often called the line organization) and the workers. The company's operating organization looks to the personnel department for aid in maintaining the needed supply of capable workers; for help in developing and maintaining the workers' competence; for developing and maintaining safe working conditions and effective environment; for maintaining the needed personnel records; and sometimes for assistance in determining wage policy, methods, and rates.

The worker expects aid from the personnel department in assuring him of fair treatment in such matters as "fringe benefits," assurance of his rights with respect to various aspects of the labor contract such as seniority preferences, for health protection, often for cafeteria service, sometimes for advice on personal matters such as finances.

The extent to which the personnel department is responsible for services to the operating organization and to the workers differs from company to company. The trend definitely is in the direction of broadening the scope of these services. At the same time there is growing recognition of the fact that much of the work of the personnel department to be most effective must be done through the line organization. Many companies have effective suggestion systems whereby workers are rewarded for suggestions for operating improvements. In many of the better systems the personnel department is responsible for the design of the system and the mechanics of its operation. However, the worker's point of contact with the system is his own foreman, who may help him in preparing the suggestion, who sees to it that the suggestion is processed, who informs the worker of the results of his suggestion, and who, if an award is made, often hands the check to the worker. Thus the operation of the suggestion system becomes the dual responsibility of the line foremen and the personnel department. Experience has shown that when the service department works in the background and thus supports the line organization more suggestions are forthcoming and that company-worker relations through the foremen are strengthened.

4. SCOPE OF PERSONNEL DEPARTMENT ACTIVITIES

The following list covers many of the activities by means of which the personnel department renders service to the line organization people and to the employees.

Forecasts of manpower requirements
Maintenance of a manpower inventory
Recruitment of workers
Selection of workers from among applicants
General indoctrination of workers with respect to company policies, rules, facilities, and the like
Training of workers, or training of the supervisory group in training methods
Providing younger workers with opportunities to improve themselves through company-supported educational activities
Evaluation of workers
Promotion of workers
Transfer of workers
Layoffs
Discharges
Discipline
Grievance settlement
Record keeping
Wage policies
Determination of community wage levels
Job analysis and evaluation
Merit rating
Wage structure
Fringe benefits, such as group life insurance, group health and accident insurance, retirement pension plans, stock purchase plans
Loans to workers
Safety programs, rules, and instruction
Recreation facilities
Food
Housing

Communication
Transportation
Plant security
Company publications, bulletin boards, etc.

In some companies this list of activities may be broadened to include industrial relations activities such as union-company contract bargaining and community relations such as contributions to local charitable activities and to educational institutions.

Of somewhat more recent origin is the extension of the responsibility of the personnel department to include in whole or in part the upgrading of the company's supervisory force and even its management personnel. Executive development has come to be a matter of major concern in many companies. There seems to be little reason to expect that at the middle-management level a strong personnel department could not be effective in providing upgrading facilities. Few personnel departments are equipped to serve equally well in improving company resources at the upper-management level. Where top-management development programs have been most effective, they have been the responsibility of a separate organization, not a part of the personnel management function as commonly carried on.

5. THE PERSONNEL PROBLEM OF THE JUTE BAG COMPANY

The foregoing description of personnel work indicates the character of the problem faced by the Jute Bag Company in its efforts to improve its personnel situation.

For more than half a century the company had manufactured bagging in the little town of Brighton, in a Middle Atlantic state. The village of Brighton was located some 20 miles from a large industrial center. The mill was the only manufacturing concern in the town.

At the time the plant had been established there was no town of Brighton. It had grown up around the mill, and most of the buildings, both public and private, had been built by the Jute Bag Company. More than 90 per cent of the 2,200 employees lived in company-owned houses. The public school buildings had been built by the company and later deeded to the village. The company had also erected most of the store buildings. Likewise, over a period of years, it had built a clubhouse, a restaurant, a gymnasium, and a moving-picture theater. It owned and supervised a large park and an athletic field. When it had seemed to the management that these facilities had been needed, the company had supplied them. This was about the extent of the company's personnel activity.

6. LABOR SUPPLY

Workers for the plant were secured from the large industrial center 20 miles distant. The Jute Bag Company retained an employment agent in that city. Originally, employees were native Americans, with Pennsylvania Dutch stock predominating. After 1895, Scotch and Irish immigrants flocked to the mill. By 1930, most of these had been replaced by workers coming from central and eastern Europe. Currently a large majority of the employees were Poles who could neither read nor write the English language. Extensive use of interpreters was necessary.

7. SUPERVISORS

Foremanship positions were held almost entirely by workers of Scotch extraction. These men, for the most part, had been trained in Scotland and, while they were excellent workers, their ideas of mill routine were the same ones they had held in Scotland 25 years previously. As a class, the supervisors were conscientious and determined, but they regarded with open distrust such innovations as the use of a stop watch, time and motion studies, and the more modern methods of wage payment.

8. DECLINE IN PRODUCTIVITY

The management of the Jute Bag Company was acutely aware that productivity in the mill was gradually falling. Quality, which was a consideration of some importance, was becoming more difficult to control. An investigation of conditions showed that a wide gap existed between workers and foremen. The Scotch overseers appeared to be fair and just to the workers, but they had no great respect for the Polish employees and found it exceedingly difficult to work with them by means of interpreters. Much of the actual supervision consisted of illustrating to employees by means of personal example just how a given task should be performed and of punishment for minor infractions of working rules.

The workers had developed a pronounced antagonism to the management and appeared to be working for the Jute Bag Company only because they did not know how to get a job outside of Brighton. There was some evidence that employees were being exploited by their interpreters. Workers appeared to stand in great fear of what an interpreter might tell the foreman. There was no company loyalty or *esprit de corps*. Outwardly, things were calm, although supervisors occasionally received unsigned threatening letters, and there was growing talk of the possibility of union organization. The management regarded the whole situation with growing uneasiness.

9. A READY-MADE PERSONNEL PROGRAM

Jute Bag was a family owned and operated company. One of the brothers who was vice-president of the company made a trip to New England, during which he visited a large textile plant operated by a college classmate. He was very much interested to find that within the past year this company had centralized its extensive personnel activities in one department. The man in charge of this work occupied an important executive position in the company organization and enjoyed the title of assistant to the president in charge of personnel.

This textile mill, though employing foreigners, did not have the same nationality problem as did the Jute Bag Company. Interpreters were unnecessary. The foremen, moreover, were all American-born and were much in advance of the Scotch overseers as far as breadth of understanding was concerned. An employment department had been in successful operation for 10 years. Although some of the foremen had balked at such innovations at first, they had long since become used to them. The foremen regarded them in the same light as the cards and the spinning machines—all a part of the game.

The vice-president of the Jute Bag Company was enthusiastic over what he saw in this textile mill. The workers were bright and alert and could easily explain the details of their jobs. To the vice-president they appeared to be fairly bubbling over with loyalty to their company. The executive returned to Brighton thoroughly convinced that a solution to the problem facing the Jute Bag Company lay in the adoption of a plan similar to the one in force in the textile mill.

At first other officers of the Jute Bag Company were little impressed with what the vice-president had seen, but the more he talked the more sympathetic they became, and it was finally decided to secure a detailed copy of the personnel program used in the New England plant.

A study of the plan thus obtained showed that personnel work in the New England mill included 10 divisional activities: employment, health, safety, sanitation, recreation, education, systems of wage payment, stock ownership, pensions, and miscellaneous. Some idea of the extent to which details of various activities had been worked out can be seen from the following summary of the employment division's activities.

The functions of the employment department are as follows:

1. To maintain an adequate labor supply for all production, mechanical, and outside departments
2. To adjust the labor supply within the organization by means of transfers
3. To adjust disputes between workers and overseers when called upon to do so'
4. To terminate the employment relation between an employee and the company after investigation has assured the employment manager that such action is to the best interests of the company
5. To maintain adequate records for all individuals who have sought or entered into employment relations with the company
6. To summarize available statistics so as to show tendencies in the supply and permanency of labor in the production, mechanical, and outside departments of the company
7. To cooperate with all departments in all matters where any questions of labor supply or maintenance are involved

Each of these details was further subdivided. For example, instructions relative to the task of "hiring" covered several printed pages and explained clearly and in careful detail just how this function was to be carried out.

A study of the details of the personnel program convinced executives of the Jute Bag Company that these activities had been worked out and correlated very effectively. There seemed to be little doubt about the efficiency of the plan as applied in the textile mill. Some of the officials, however, were not certain that such a program was best suited to the needs of the Jute Bag Company, and they asked that more study be given the whole matter.

The vice-president who had made the trip to New England volunteered to investigate personnel activities in a number of other plants. He was somewhat surprised to discover that while most of these plants had personnel departments, the scope of the work of these departments varied greatly. He obtained detailed descriptions of the personnel activities at several of these plants. His reports and these descriptions were the subjects of considerable discussion by the executives of the Jute Bag Company.

10. WHAT THE COMPANY DID

Eventually the company executives came to the conclusion that no one of these plans exactly satisfied the situation at Brighton. A consulting firm that specialized in personnel management was contacted, and a senior partner of this firm came to Brighton. After a brief study of the Jute Bag situation, this consultant met with company executives. He told them that in his opinion no consulting firm could do much for the company at that time. He considered the situation critical. He urged that the company locate an experienced and able personnel man and bring him into the company. He said that any desirable man would insist on great freedom of action. In his opinion no person capable of coping with the situation would come to the company unless he was assured of such freedom. Once an able person had worked out an approach to the problem and a program for meeting it, the consulting firm would undertake to work with the company if it wished. He stated flatly that until a capable and experienced person was placed in full charge that anything his firm might attempt would be a waste of money.

11. A PERSONNEL MANAGER IS EMPLOYED

As a result of a three months' search conducted jointly by company executives and the personnel consulting firm, Mr. Peter Czerski came to the Jute Bag Company as vice-president in charge of personnel. Mr. Czerski had been born in Poland and spoke Polish fluently. He had come to the United States as a youth and had received a high-school education in this country in a community that was largely Polish. After working for several years in a New England textile mill, he had attended the Southern Textile Institute from which he had been graduated with grades that placed him in the top 10 per cent of a graduating class of 45 men. Following his three years at Southern Textile, Peter Czerski returned to the textile company for which he had worked earlier. Over a period of 10 years he was employed there as lead hand, shift supervisor, assistant to the mill manager, and finally director of personnel. The conditions under which he accepted the Jute Bag position were such as to receive the full approval of the consultant who first had investigated the situation at the Jute Bag Company.

12. SUMMARY AND CONCLUSIONS

A Personnel Program for the Jute Bag Company. At the end of three months Peter Czerski made his first formal report to the executives of the Jute Bag Company. In it he gave a detailed appraisal of the company's employee and personnel situation, a statement of what he believed had to be accomplished, and a program for doing it. He emphasized two critical needs. Most important was the development of a capable group of supervisors. He believed that few of the present supervisors would be able to make the changes so badly needed. There were no men in the company's work force able to assume supervisory responsibilities immediately. However, his investigations indicated that many of the experienced mill hands had basic capacity to develop into good supervisors. He believed that little headway in improving the general personnel situation could be made until an entirely different understanding of supervisory work and responsibility was established in the mill.

The personnel manager's second most important recommendation was that the company undertake a broad-scale citizenship program for all its workers, both men and women. Many of these people wished to be United States citizens; most of them were capable of qualifying. Brighton had no facilities, such as evening classes, to assist the workers to gain citizenship. Czerski urged that the company organize a citizenship program for employees and at the same time provide classes in which workers might learn to speak, read, and write English. He had consulted local school authorities and had found them enthusiastic about the organization of such facilities. The cost to the company would be nominal.

A Foremanship Program. The personnel vice-president recommended strongly that the Jute Bag Company organize and operate a foreman development program for its Polish workers. He had a list of 52 such employees whom he believed currently competent to undertake such training. The ages of the men in this group ranged from twenty-eight to forty-two years. All of them were excellent workers. Most of them spoke a little English, although only six of them could write the language. Czerski had worked out a training program which a man could complete in evening classes over a two-year period. While he had said nothing to these workers about supervisory training, he had talked with all of them about a citizenship activity and had found that without exception they were much pleased with the suggestion that the company might consider doing something of this sort. Czerski was certain that worker interest in this would expand to ready participation in the foreman training program he urged that Jute Bag undertake.

A Home-ownership Program. The personnel vice-president made a third recommendation. He believed that foreman development and citizenship activity were the two most immediate needs. In addition he wanted an even more tangible and obvious demonstration of the company's interest in its employees. Most of the workers lived in houses built, owned, and maintained by the Jute Bag Company. Rental charged for these houses was very low, and while the company always kept these premises sound structurally no attempt had been made to have them attractive as homes. Czerski proposed that the company sell these houses to the employee occupants. He believed that if the properties were priced in relation to their original cost (they averaged twenty years old), and if financial arrangements included very low down payments, low interest rates, and modest weekly deductions from pay checks, that a steadily growing number of employees would endeavor to own their homes. He recommended that his department undertake an active program in stimulating home ownership. When a worker showed interest in buying, the company should at once thoroughly renovate the property the worker considered purchasing. This should include all needed structural repairs, complete inside decoration, and outside painting. Company houses always had been painted an economical gray or brown. Czerski suggested that when the firm sold one of its houses to a worker, the company repaint the house white or in some light color chosen by the purchaser. He further recommended that when a house was sold, the company build an inexpensive carport for the buyer. None of the company houses had garages. Many workers owned cars. He believed that a carport, which would cost little to construct, would enhance the prestige of the property and of its buyer-occupant very substantially.

Czerski knew that Polish workers were strong believers in owning a home. He was certain that, given the opportunity, many of Jute Bag's employees would make great effort to own the houses they occupied. Furthermore, he was convinced that once a worker purchased a house under the conditions he proposed, the new owner would take great pride in its possession and constantly work to improve the property and make it attractive. Czerski said it might take a little time to get this program to become self-developing. He was sure, however, that once a half-dozen workers had taken the step, the obviousness of the increased status of these workers as home owners would result in a steadily increasing desire of other workers to take advantage of the company offer. The personnel vice-president had figures indicating that over a 10-year period the net cost to the company of the home-ownership program would not exceed $220,000.

Czerski proposed that for the next two years the company's personnel program focus on the foregoing three activities: citizenship for all, foreman training for a selected group, home-ownership promotion. Slowly the more common activities of a personnel department would be developed. If the program he proposed for the next two years were successful in changing the general climate of employment at Jute Bag, further steps would become relatively easier. Czerski was confident that the program would produce the desired results. He was equally sure that until a basic change in general attitude was developed, little could be expected from the more usual personnel activities and routines. At a second meeting following Czerski's presentation of his program, the executives decided unanimously to adopt the personnel vice-president's proposals.

Appraisal of the Jute Bag Company Situation. A fundamental consideration underlying any plan of personnel organization is that the activities in question should be suited to the individual needs of the company undertaking them. In fact, there is no justification whatever for setting up personnel activities except in terms of specific requirements.

Even a casual survey shows that the situation in the bag plant differed basically from that found in the textile mill. The difficulties in the former plant arose in part from the fact that foremen were nonprogressive. They distrusted innovations of all kinds. They did not sense the spirit of management as found in most American factories today. A real loss of contact between management and workers had taken place. Such contact was not easy to reestablish because of language barriers and racial jealousies which made it very difficult to develop and maintain a friendly, cooperative group consciousness on the part of the working force.

In the textile mill the situation was quite the reverse. Language barriers and racial jealousies, if they ever had existed, had been broken down. The worker group was animated by a spirit of loyalty and friendliness to the management. Overseers were alert and willing to adopt the most modern means for increasing productivity. The scope of the personnel activities which had been developed at the textile mill is to be taken as evidence of the extent to which the management had put its house in order before consolidating all personnel activities under one executive. Devices for personnel control can be used successfully only when they harmonize with production conditions in the plant.

There is no reason to believe, for example, that the adoption of the textile mill plan by the Jute Bag Company would in any way make its foremen more progressive, reestablish a real contact between workers and management, or in any other way motivate the workers to increased productivity. Executives of the Jute Bag Company had to work out their problem along lines peculiar to their situation. They could not adopt a ready-made plan and expect it to work. Standardization in managerial control has not developed to that extent, and there are no present indications that it will do so.

Solution of Jute Bag Company Problems. It appears that a commonsense analysis of the problems faced by the Jute Bag Company would lead to the conclusion that the first thing needed was provision for foremanship training. This program could not be primarily for the Scotch overseers, for they were, except in isolated cases, beyond the reach of any training course. The program had to be focused on the development of the more promising Polish workers, looking forward to the day when such employees could assume foremanship responsibility. The other pressing need was for an Americanization program for the workers. The English language and an understanding of the ideals underlying American institutions could be stressed. The present language barrier was serious, and an appreciation of American institutions was indispensable if the company wished to forestall the development of ideas harmful to those institutions. A program designed to foster citizenship certainly could not be construed as paternalistic. Rather it was constructive democracy.

The home-ownership program seems sound as a service both to workers and to the company. It was a fitting demonstration of a new company spirit and attitude and would seem a valuable adjunct of the citizenship and foremanship programs. The gain to employees is obvious. If the $220,000 cost estimate was reasonably accurate and if the program accomplished its basic purpose (as seemed probable it would), the price of $100 per person for developing a new worker attitude toward the company was low indeed. It is very doubtful that much else in the way of a personnel program, except possibly organized recreational work and the establishing of systematic employee records, would have been of immediate service to this company. As, however, a group of Polish foremen became trained in more modern methods of process and personnel control and as workers learned to understand the English language and gain some appreciation of American economic, political, and social institutions, ways would be opened for an enlargement of personnel activities. Devices such as the installing of scientific methods of performing tasks, incentive methods of wage payment, and plans for worker communication normally would follow in the development of a comprehensive program. Such plans cannot, however, be safely injected into a situation until a firm foundation has been built.

Summary. A system of personnel control is only one factor in effective management. If personnel work is to develop successfully, it must maintain a very close relationship with other managerial developments in the factory. Personnel devices should be installed and used only when they perform definite functions. The ill-advised attempts of companies to gain wholesale benefits by establishing complete, ready-made personnel departments usually result disastrously both to the treasury of the company and to the very cause they are supposed to advance. The reason for failure is that the personnel devices have not been sufficiently correlated with the operating program as it is carried on from day to day.

Personnel work is very necessary. It is hard to overestimate its importance in any scheme of modern management. Personnel devices must, however, be used with discretion. In and of themselves, they neither advance the cause of management nor further the welfare of employees. When, however, they are used intelligently and in conjunction with other sound operating methods, they are very powerful aids making for effective management. The question of whether a personnel program should assume one specific form or another, whether it should be centralized or decentralized, is of secondary importance. Substance and not form should be the controlling factor in establishing any personnel policy. If the substance of a given program is sound, the particular form that it should assume can be worked out over any reasonable period of time.

Personnel Activity and Human Relations. Since the days of the Hawthorne experiment at the Western Electric Company in the early years of this century, much has been learned about people in industry, why they think as they do, why they react as they do. A science of group relationships and group reactions slowly is evolving. Social and organizational relationships within a company's work force are beginning to be understood. Sociologists have found the business organization an intriguing and profitable area in which to pursue their studies and develop understanding of societies in the large. The gain to industry can be substantial. But as has been true of economics, statistics, and engineering, business executives will have to develop the uses of the evolving principles and methods of sociology if they are to become useful tools in the practice of sound personnel management. Managements cannot depend upon the sociologists to do this applications development for them. Understanding of economics is a great aid to the business executive. The same is true of engineering and of certain mathematics. But neither economic theories, engineering, nor mathematics, nor all of them together will assure able management. The same should be pointed out with respect to sociology. The contributions of all these disciplines can be important. Experience indicates that on the business executive rests the responsibility for making these potential contributions real. Understanding of what now is known about human relations is essential to the effective personnel manager. Development of effective utilization of this knowledge has become a continuing function of the personnel executive. His researches in this direction are indispensable.

QUESTIONS

1. Enumerate some of the activities carried on by personnel organizations.
2. What was included in the New England textile company's plan of personnel organization? Why was each activity included?
3. What were the outstanding labor problems facing the Jute Bag Company?
4. In just what ways would the adoption of the plan used by the textile company have tended to solve, or not to solve, the problems faced by the Jute Bag Company?
5. What do you think of the procedure followed by the Jute Bag Company respecting a personnel organization?
6. What is the justification of including Americanization as a part of the personnel work of the Jute Bag Company?
7. What were the objectives of the company's home-ownership program?
8. Why do you suppose the text says that "personnel devices should be installed and used only when they perform definite functions"?
9. When executives of the Jute Bag Company were looking for someone to develop a personnel program for the company, what qualities, abilities, and skills should they have been seeking?
10. Why did Czerski believe that foreman development was the first and most important thing to be done?

PROBLEM 45 NATIONAL UNION COMPANY ELECTRONICS DIVISION

Mike Warren was employed as a "test administration specialist" in the Electronic Division of the National Union Company. In March, 1960, the company deemed it necessary to reduce the work force to conform to the lightened work load in the division. The test administration specialist position was not essential to the department's curtailed operation and was a logical position to eliminate during a cutback. Consequently Mr. Robert Chamberlain, personnel director at National Union's Electronic Division, had to decide what to do about the incumbent, Mike Warren.

The National Union Company was one of the largest manufacturers of electrical goods in America. The company had more than 200,000 employees in 1960. Manufacturing activities were carried out in 80 plants located throughout the country. The company's Electronic Division plant was in St. Paul, Minnesota.

National Union's labor policy was considered to be one of the most progressive in American industry. For example, a noncontributory pension plan had been inaugurated as early as 1912. Many other plans designed to increase employee benefits had been adopted. In 1936, the company had inaugurated a plan which adjusted earnings to the cost of living.

For years the company's relationship with its employees had been satisfactory, and it was not until 1946 that the company experienced a major strike. After eight weeks of negotiations, this strike was settled. But in the words of the company's president, "More than just an enviable labor record came to an end in 1946." Since then, relations with the union had been "less than completely satisfactory."

Mike Warren was born in 1912 in St. Paul, Minnesota. He attended grade school and high school in St. Paul and later spent four years at the University of Minnesota, where he received a law degree in 1939. A few years after his graduation he took the state bar examination but did not pass it. Soon thereafter he joined the Electronic Division of the National Union Company.

Warren's first job was testing components which eventually would be used in building electronic computing machines. These components were made with extreme precision, and each of them had to be tested individually. In this capacity Warren was rated as a "class B tester."

Mike adjusted to company conditions quickly. He joined the local chapter of the Union (United Electrical, Radio and Machine Workers of America), and his fellow workers said that he was a "regular guy."

In November, 1947, Mike's progress was rated satisfactory by the test section supervisor Mr. Jones, and he was promoted to be a "class A tester." The job of a class A tester was more difficult than a class B tester's job. It consisted of performing electrical, mechanical, hydraulic, and running tests on all types of electronic equipment and computing machines. The job also included making special tests for engineering information, recording necessary data, using all types of test instruments, and performing all duties of a class B tester.

Warren worked as a tester until February, 1949. At that time Mr. Kent who was assistant to Mr. Jones was transferred to another plant as a supervisor. A replacement for Kent had to be found. After reviewing the work and the progress of his testers, Mr. Jones recommended that Mike Warren should succeed Kent. This recommendation was accepted by Mr. Richard Mallon, manager of the quality control department, and was approved by the manager of manufacturing. When Mike became assistant supervisor of the test section, he automatically was dropped from the union bargaining unit because as assistant supervisor of the section he was considered a first-line manager.

There was no major change in personnel in the test section until November, 1955. At that time Mr. Jones, the section supervisor, was transferred to another division of the company. Mr. Richard Mallon, manager of the quality control department, immediately looked for a man to succeed Jones. He was unable to find an experienced replacement and in December, 1955, Warren was instructed to act as supervisor of the test section until a permanent supervisor was found. The job of this supervisor is described in Exhibit 1.

Exhibit 1 National Union Company Electronic Division Position Guide, Supervisor, Test Section

Position Title: SUPERVISOR—TEST SECTION
Accountable to: Manager—Quality Control Department

I. FUNCTION OF POSITION

The Supervisor—Test is responsible for conducting the activities of the Test Unit. He has managerial and functional responsibility for assuring the development and proof testing of electrical and mechanical equipment to meet predetermined schedules, quality, budgets, and costs, for maintaining high productivity with good employee morale, and for providing leadership for those under his supervision.

II. PRINCIPAL RESPONSIBILITIES AND RELATIONSHIPS

A. Managerial Responsibilities

As the supervisor of one or more subunits he is responsible for getting work done through others by providing leadership in:

Planning

Develop both short- and long-range plans and objectives for the most efficient utilization of the men, machines, and material assigned to his supervision.

Organizing

Develop and maintain a sound organization structure and recommend to the Manager—Quality Control any changes consistent with good business practice.

Integrating

Provide for the effective utilization of the resources of the unit. Communicate all objectives, plans, programs, budgets, etc., to subordinates, to Manager—Quality Control, and others as necessary. Teach, advise, counsel, and review the performance of his people in the most effective use of their time and effort and inspire them as a team to perform most effectively.

Measuring

Establish standards of control and measurement for his people. Develop a clear, concise reporting system to communicate adequate and timely data.

B. Functional Responsibilities

Select, train, supervise, and recommend compensation of any Foremen under his supervision.

Assure that Foremen under his jurisdiction select, train, and maintain an efficient direct and indirect labor force for their operations in accordance with available facilities and established schedules.

Assure that production operations and the flow of raw materials and parts through the subunits under his supervision meet established cost standards and work closely with Foremen and with Manufacturing Engineering personnel for the reduction of direct and indirect costs as they apply to his operations.

Direct the efforts of any Foremen under his supervision to maintain established time cycles for their operations and to improve such time cycles where possible in order to minimize work-in-process inventory.

Assure adequate maintenance of machinery, tools, and equipment under his supervision by requiring prompt issuance and follow-up of appropriate orders.

Assure active and satisfactory participation by the subunits under his supervision in such programs as safety, good housekeeping, suggestions, cost reductions, employee relations, etc.

Assure the satisfactory administration of approved personnel policies and the maintenance of good employee relations and high morale.

Assist the Manager—Quality Control in preparing various budgets for the control of operations for the unit under his supervision.

Analyze and report to the Manager—Quality Control the results of operations, account for variations from budgets, plans, and schedules, and recommend improvements.

C. Relationship Responsibility

1. *Within the Department*

   Manager—Manufacturing, Manager—Materials, Superintendent, Production Supervisors, General Foreman, Foremen, Engineering personnel, Marketing personnel, Employee Relations personnel, Union Stewards, individual employees.

2. *Outside the Department*

   Inspectors, vendors, customers.

III. AUTHORITY OF POSITION AND RESERVATIONS OF DECISION-MAKING AUTHORITY

1. *Final Authority*

   Except as reserved by the Manager—Quality Control, the Supervisor—Test has authority to accomplish the fulfillment of the responsibilities and duties as set forth above.

2. *Reservations of Authority*

   The following are examples of authority reserved from the Supervisor—Test:

Personnel action relating to any Foremen reporting directly to him

Establish departmental budgets

Rearrangement of facilities

Approval of appropriations

IV. MEASURES OF ACCOUNTABILITY

The Supervisor—Test is responsible for the fulfillment of the responsibilities assigned to his position and for the quality of his performance. Some factors for measurement are:

1. The adequacy of training provided any Foremen.
2. The effectiveness of his Foremen (if any) in the execution of their assignments.
3. The administration of his Employee Relations program.
4. The cost of complaints caused by Test personnel action.
5. The effectiveness of his efforts in meeting production schedules within scheduled hours.
6. Safety record, cost reduction activities, and housekeeping record.

During 1956 Mike Warren took courses in conference leadership, labor law, and wage and salary administration after working hours. These courses were part of the company's leadership training program. During this time he also was studying for the state bar examination which he passed in 1959.

Two years after Mike Warren first became acting supervisor of the test section, the Electronic Division's work load dropped considerably. This was due to a curtailment of spending by the Federal government, one of National Union's biggest customers. The cutback in work in the Electronic Division necessitated a reduction in hourly employees. This in turn required a reduction in supervisory personnel. In March, 1958, as a result of this cutback in work, the test section was reorganized. Although no job specifications were changed, several jobs were eliminated.

In the opinion of Mr. Mallon, quality control manager, the reorganized test section required men with a higher degree of mechanical and electrical skill and more experience than had been necessary before the reorganization. Electrical, mechanical, and hydraulic tests had been assigned to different testers prior to the reorganization; now all types of tests were done by each tester. Mr. Mallon knew that Mike Warren did not have a formal technical training. Therefore, to assess Mike's effectiveness he decided to observe his work frequently during the next few months. During his observation Mallon noted that Warren's subordinates frequently were not obeying his orders. One of the testers, James Randolph, was particularly disrespectful of Mike. Randolph, who had taken an electronic course in the Navy, seemed to enjoy ridiculing Warren in front of the other testers. On September 9, 1958, after six months of observation, Mr. Mallon decided that Mike Warren was not measuring up to the requirements of his job. The next morning he called Mike into his office. He told Mike what he had observed. Mike replied, "Yes, I know. Those fellows think I don't know anything about electronics. Let me tell you, those kids may know more theory, but I certainly have more practical experience. Why, what do you think I have been doing these 11 years? I have come up the hard way, and I intend to stay where I am."

Mr. Mallon replied, "You may have a point there, Mike. However, since the reorganization your job has become more technical. According to our records you have a law degree. Have you ever thought of making use of it? There is a vacancy over in the personnel department as supervisor of health and safety. This position was created during the reorganization, and they are looking for someone to fill the job. I'll put in a good word for you if you want the job. With your background I think you really would do well in it."

Mike replied, "Sorry, Dick, I am not trained for any job in personnel. Besides I do not want to throw away 11 years of experience. I just want to stay where I am. If you don't think I can handle my men, why not put me back as a tester?"

Mr. Mallon concluded the interview by saying, "Mike, why don't you think about it. If you change your mind, let me know."

After Warren left his office Mr. Mallon picked up the telephone and called the personnel director, Mr. Chamberlain. He told Chamberlain the conversation he had with Mike. He concluded the telephone call by saying, "I think Mike is not doing the job. I'd like to get him out of my section. See what you can do for me, will you? I'll sure appreciate it. Thanks, Bob."

A week later, September 17, 1958, Mr. Chamberlain called Warren into his office. He said, "Mike, I understand you and Dick Mallon talked about a job in personnel. Have you made up your mind about taking the job?"

Mike replied, "Yeah, but it's not for me. Nothing personal, Bob. As I told the boss (Mallon) I'm not trained for it. Besides, I like my job. I just want to stay where I am."

Mr. Chamberlain replied, "You see, Mike, we think you can be a great asset to the company if you are put in a position where you can use your training and background. For example, there is an opening in the sales department. We think your legal background would come in handy there."

Mike answered, "Sorry, Bob, I'd rather stay where I am."

"O.K., Mike," Mr. Chamberlain concluded, "if you are so set on staying where you are I'll see what I can do for you. But I wouldn't count on it if I were you."

Warren did not see Mr. Chamberlain for several days. On the fourth day Mike received a telephone call from the personnel director asking him to come to his office. While Mike was in Chamberlain's office he was informed that his new title in the test section would be test administration specialist and that another employee, a graduate of the company's student engineering program, had been made supervisor of test over Mike.

Afterward in commenting on this conversation Mr. Chamberlain said that the reason for the change was explained very "diplomatically" to Mike. He said that at the time Mike seemed to have accepted the explanation very well. He also said that the test administration specialist's position was not essential and that it was "a temporary assignment until a more permanent position could be found for Mike." Mr. Chamberlain also observed that the new supervisor of test had more technical training and experience than Mike Warren.

On January 12, 1959, Mr. Wilbur Norris, foreman of the assembly section, was in Mr. Chamberlain's office. Mr. Chamberlain, knowing that Norris and Mike Warren were good friends, asked Wilbur how Mike liked his new job. Wilbur told Mr. Chamberlain of a conversation which he had with Mike the previous week during a morning coffee break:

Wilbur: Mike, how's the new job going?

Mike: What the ____ do they think they are doing anyway? All these years of faithful service to the company and what do I get in return? They are not going to get away with it. I'll show them. If they want to play rough, I'll join the union and get rough with them. You wait and see!

Chamberlain replied, "That's not a surprise. I've heard from various other people that Mike wants to 'get rough' with the company. Why, he even said that to me! What do you think of that? Well, I hope everything's going to turn out all right for Mike."

After Wilbur Norris left his office, Mr. Chamberlain thought about what Wilbur had told him. He was wondering if the union would do anything for Mike, who at that time was not a union member.

In March, 1960, the Electronic Division again was obliged to reduce its work force to meet a cutback in the work load. Since the test administration specialist position was not essential, Mr. Chamberlain believed it was time to eliminate this position altogether. He called Mike Warren into his office. After a few friendly words he said, "Mike, one of our largest customers, the government, is cutting back on spending again. As you know, this means a cutback in work and a reduction in personnel. Since the test administration specialist position is a temporary position, we have decided to eliminate it altogether. John Snyder needs a quality control inspector. Report to him tomorrow morning."

Mike replied, "No, Bob, I want to stay in test."

Mr. Chamberlain was not pleased with Mike's answer. He studied Mike for a moment and then said, "Well, then, there's nothing I can do for you. You either take the quality control job or quit."

Mike was stunned. As he later described the incident, "I could not believe my ears. I stomped out of the room. That was all I could do to avoid making a scene."

Mike went directly to the union offices and spoke to the regional director, Mr. Raymond Cosgrove. He requested Mr. Cosgrove to try and get his old job on the test line back. Cosgrove listened to Mike's story and promised he would do all in his power to help Mike.

At home that night Mike wrote to Representative Michaelson of Minnesota explaining the situation. He requested Representative Michaelson to use his influence and try to get him reinstated in the company.

As a result of Mike's request Mr. Chamberlain received the following letter dated April 22, 1960.

CONGRESS OF THE UNITED STATES
House of Representatives
Washington, D.C.

April 22, 1960

Personnel Officer
National Union Company
St. Paul, Minnesota

Dear Sir:

Mr. Michael Warren, Walnut Street, St. Paul, recently admitted to the Minnesota Bar and formerly employed by you is very anxious to be considered for a position in your test section, and I will appreciate any consideration you may find it possible to extend him.

Please advise me.

With thanks and best wishes, I am,

Sincerely yours,
(Signed)
Donald Michaelson, Jr.

Mr. Chamberlain studied the letter and with the approval of the Electronics Division's general manager sent the following reply on April 28, 1960.

National Union Company
St. Paul, Minnesota
April 28, 1960

Honorable Donald Michaelson, Jr.
House of Representatives
Washington 25, D.C.

Dear Sir:

Thank you for your letter and interest regarding Mr. Michael Warren, Walnut Street, St. Paul, Minnesota.

I am sorry to inform you that at this time circumstances are such we are unable to increase our personnel. However, if and when business warrants our increasing our forces, we will be very happy to give Mr. Warren every consideration.

Very truly yours,
National Union Company
(Signed)
Robert Chamberlain,
Personnel Director

Meanwhile, Mike receiving no satisfaction from Representative Michaelson, wrote a letter to Mr. Coleman, president of the National Union Company.

Walnut Street
St. Paul, Minnesota
May 14, 1960

Albert Coleman, President
National Union Company
New York, N.Y.

Dear Mr. Coleman,

I hope you will forgive my appealing to you personally. I have enclosed clippings which will give my background and position in the company. As you will notice, I was accepted as a Minnesota attorney by the Minnesota Supreme Court last November. I was fired from National Union in March, apparently, for my reluctance to take a transfer, although my record is admittedly excellent. I talked to the general manager and gathered that had he known of the facts sooner a different result might have been achieved.

Having come up through the ranks and feeling that my background now had become a detriment rather than an asset to real upward promotion, I elected and was granted permission to return to my original position as a tester. Due to widespread comment of persecution throughout the plant which I had no part of nor encouraged, as I was content to have a job, the management called me on Friday, preceding the Monday I was to take up my new duties, and requested me to resign or be fired.

At the age of forty-eight it is difficult to support a family as a new attorney. My hopes had been to remain with National Union and use my background for the company.

Because the job of tester is covered by the bargaining agreement, the local union has expressed interest in the matter.

I feel that my ambition and hard work to succeed in life have acted to my detriment. I was never fired in my life although I have worked for over thirty years, having started work at fourteen. National Union has always manifested its interest in the promotion of the better way of life and the encouragement of education and the progress of mankind. I honestly feel that the company would not knowingly permit unequitable handling of its employees.

Firing is an extreme measure, a reflection on the character of the individual and a stigma on his name, and I honestly feel that I am far from meriting such a reward.

I do appreciate that company policy in such matters might act as a hindrance in reconsideration, but I feel that you are interested in the equitable administration of such a policy.

I will be deeply grateful to you and the company if you can see your way clear to alleviate this decision.

Respectfully yours,
(Signed)
Michael Warren

As a result of this letter, the president immediately requested a complete report of the Mike Warren case from Mr. Edward Gibson, manager of the Electronics Division.

Mike's visit to the union office brought action in the form of a union complaint. On December 16, 1960, Mr. Raymond Cosgrove, regional director of the union, charged:

> That on or about March, 1960, and at all times since that date, the employer through its officers and agents has discriminated against Mike Warren by refusing employment to him in order to discourage membership and activity in Local 135, International Union of Electric, Radio and Machine Workers, American Federation of Labor, Congress of Industrial Organization.
>
> By these and other acts, the employer has interfered with, restrained and coerced employees in the exercise of rights guaranteed by the National Labor Relations Act.

The charge was processed through the company grievance machinery and then was investigated by the National Labor Relations Board. The NLRB ruled that the union had no cause for complaint against the company in its actions. The board ruled that the discharge was not discriminatory.

In January, 1961, the work load at the Electronics Division increased and the company was obliged to add to its work force. Mike Warren immediately sent a letter to Mr. Robert Chamberlain dated January 9, 1961, which read:

Dear Robert,

I understand that there is an opening for a tester in the test section and I would like to make application for the same.

Sincerely,
(Signed)
Mike Warren

A week later, Mr. Chamberlain received another letter from Mike Warren asking for a National Union Company scholarship for his daughter. His daughter was finishing high school and was planning on going to college in the fall.

After the NLRB's ruling in favor of the company, the union appealed and immediately filed another complaint against the company. The second complaint was essentially the same as the first one in context.

Mr. Chamberlain had to make a recommendation with respect to Mike Warren's requests to his immediate superior Mr. Edward Gibson.

QUESTIONS

1. Please be prepared to give an appraisal of the various decisions made by management with respect to Mike Warren during the time period covered by this case.
2. What course of action should Mr. Robert Chamberlain, personnel director, recommend to the general manager of the Electronics Division of the National Union Company?

PART 3

CONTROL OF THE PRODUCTION PROCESS

18

PRODUCT DEVELOPMENT AND INTRODUCTION

WESTERN ELECTRIC COMPANY, INC.

1. AN ELECTRICAL EQUIPMENT MANUFACTURING COMPANY PREPARES TO PRODUCE A NEW PRODUCT

Engineering work involved in preparing for the manufacture of a new product was part of the work of the planning departments in the plants of Western Electric Company, Inc. This work included setting up various operating standards essential for economical production and for control of the manufacturing process, and also improving on the original designs furnished by other departments. This preproduction planning was considered of great importance because, in the words of a company executive, "the ability of a manufacturing institution to produce a quality product, at a proper price, within a predetermined interval, is only equal to its ability to do a satisfactory engineering job in the first place." For production of the telephone handset, the planning department was able to effect many savings.

2. PREPARING FOR PRODUCTION

Between the origin of the idea of a new product and the actual manufacture of the product, a vast amount of design, planning, and preparation must take place. The product must be designed, tested out, redesigned, and retested—sometimes a lengthy and costly process. When a satisfactory design has been evolved, the methods of manufacture must be planned in detail. When these plans are satisfactorily completed, the requisite facilities for production must be provided. These, of course, include equipment and tools, raw materials, and workers.

3. DESIGNING THE PRODUCT

The design of a new product must be carried out from three points of view, which we shall call functional design, market design, and production design.

Functional design has to do with the performance of the product in use. If one were to design a new lawn mower, he would surely make certain that it would cut grass. He would so design it that it would cut evenly and cleanly and would endeavor to have it cut everything in its path. The design should be such that the mower could be pushed easily. The less effort required to operate the mower, the better. Another aspect of design would be durability. The mower should continue to function well for a long time, to stay sharp, and to push easily. There are other matters of design having to do with the functioning of the new mower which would probably be considered; these might include provision for lubrication, amount of noise made by the mower when operated, and similar characteristics of the machine. Since functional design has to do with performance in use, it is obviously of primary importance in planning a new product.

It is not enough that a product do well the work for which it is intended. In addition it must appeal to people who might be interested in buying it; it must incite consumer demand. Much of the "streamlining" that has been done on many products has been in the interest of market appeal. Streamlining a lawn mower does not improve its ability to cut grass. Recently "de luxe streamlined" lawn mowers have come on the market; they have a more attractive appearance than the orthodox models. At least one manufacturer of lawn mowers included in a recent line several models featuring "centralized lubrication." These mowers had but one point to be oiled; pipes and ducts carried the oil from the central reservoir to the various friction points of the mower. It is doubtful if centralized lubrication improves lawn mowers functionally, nor does it seem probable that convenience in use is increased. Nevertheless "centralized lubrication" may be an important feature if it increases the competitive appeal of this manufacturer's products. Designing products to increase their buyer appeal apart from superior functioning of the product is familiar practice and an important requisite of the well-designed product.

Excellent functional and market design are of no greater importance than design in terms of production cost. The idea that a better mouse trap will cause a path to be beaten to your factory door is good only if you can make that mouse trap at a cost low enough to permit an attractive purchase price. Cost of production is greatly influenced by product design. It usually costs less to cast or to punch holes than it does to drill them. Thus good design from a production standpoint will, if possible, permit the casting or punching of such holes as are required. Also, the fewer holes needed, the lower will be the cost of making holes. Few products designed in terms of function and market appeal are suitable for profitable production until they have been thoroughly redesigned in terms of manufacturing ease. Changes in design to simplify processing must not sacrifice excellence of functional and market design. Occasionally some compromise between the three is necessary, but design excellence aims at a maximum of all: functional perfection, consumer appeal, and low cost of manufacture. It is the combination of the three that puts design on a business basis.

4. PLANNING PRODUCTION

Once satisfactory design has been achieved, it is necessary to plan the methods of production. Product specifications must be restated as manufacturing specifications, processing methods must be determined, and control methods and standards must be worked out. In the case of our lawn mower, sharpness, ease of operation, durability, and appeal to the eye must all be translated into material specifications, exact shapes, definite tolerances of parts, fit, color, and color combination specifications—a thousand concrete, exact standards. These are necessary if the design of the sample that has been approved is to be repeated without deviation in the product eventually shipped to market.

These manufacturing specifications form the basis for process planning. Detailed methods to be followed in manufacture must be predetermined. Operations, specifications, sequence of operations, assembly ways and means must be worked out. When properly done, this planning leaves little to chance, and actual manufacturing costs will closely approach estimated costs.

This realization of anticipated results will obtain only if control for that purpose is provided. Inspection must start with materials and carry through to finished product. Worker productivity must be provided for. Interruptions to smooth flow of work in process must be guarded against. Everyone from the purchasing agent's clerk to the chief engineer is affected, and the correlation of the effort of all as control factors must be ensured by careful preplanning of control functions.

5. PROVIDING PRODUCTION FACILITIES

As plans for production mature, the actual provision of production facilities will get under way. These facilities include plant space, equipment and tools, suitable workers and supervisors, and the specified materials. The ability to acquire these and the cost of acquiring them, of course, will have been under consideration during various stages of design and planning. The actual acquisition of facilities takes time and should begin as early as the definiteness of plans permits. It takes time to build equipment; it takes time to prepare raw materials and process purchased parts; it takes time to train workers and supervisors.

At this stage the time element frequently becomes very important. Usually a company does not have unlimited time in which to bring out new products. Competitors may have sensed the need or opportunity for the new introduction. To keep ahead of competition, or even to keep up with it, is important. If too much time is consumed in getting new products into the market, some of the gain from them may be lost. One of the most common criticisms of the production organization voiced by the sales department refers to the length of time required to get a new product into production so that they can have it to sell.

Too much hurry in starting manufacture is as bad as slowness. Preplanning makes for profits: it ensures low costs, satisfactory quality, ability to make quick delivery promises, and then keep them. These are all-important to the success of a new product. Of equal importance is the placing of the item in the market at the most advantageous time from the standpoint of securing sales volume.

Product planning and introduction are problems of great business importance to the manufacturer. Frequently the time factor is the essence of success. The magnitude of the problem grows out of the great amount of detail involved and the necessity of correlating these details. The introduction of new automobile models each year is, in many respects, a marvelous human achievement. Fortunate indeed is the manufacturer who must face this problem rarely or has ample time to carry the planning through without rush when new products are introduced. The experience which follows is unusual in this respect; the market situation makes possible a thorough, unhurried performance of the various activities and functions inherent in the introduction of new products.

6. PLANNING PRODUCTION OF A NEW PRODUCT AT THE WESTERN ELECTRIC COMPANY, INC., PLANTS

When the development of a new piece of apparatus at Western Electric Company, Inc., had progressed to the point where executives contemplated its manufacture, the planning organization was furnished with a model or preliminary drawing of the apparatus and specifications covering its electrical and mechanical functions, the materials to be used, tolerances, quantities likely to be manufactured, etc. The planning engineers did not originate or design new products; their work included the following nine functions:

1. Studying the original design from a manufacturing standpoint and preparing a cost estimate
2. Preparing manufacturing drawings
3. Determining the kind and quantity of raw materials required
4. Planning the manufacturing process
5. Designing and providing required tools
6. Providing the proper machinery
7. Prescribing the grades of labor to be used
8. Establishing time or output standards
9. Prescribing the wage payment plan

7. MAKE-UP OF THE DEPARTMENT PERSONNEL

At the Hawthorne plant of Western Electric Company, Inc., the planning department included about 1,000 people, of whom more than 700 were engineers, mechanical designers, draftsmen, and supervisors over engineering work. The personnel was required to possess a combination of practical knowledge gained from training in factory and machine shop with theoretical knowledge acquired in college. Work was functionalized according to the various types of engineering involved. There were mechanical engineering specialists on screw machine, milling, drilling, and pressing operations; specialists in each branch of tool design; specialists on metal-finishing operations; industrial engineers specializing on methods of wage payment and allied activities; both electrical and mechanical engineering specialists on apparatus design and production; etc.

8. AN EXAMPLE OF THE DEPARTMENT'S WORK

When the design of the telephone handset had been developed by the Bell Telephone Laboratories to the point where the Western Electric Company, Inc., executives considered it advisable to proceed with production, designs and specifications for the instrument were turned over to the planning department, which was responsible for taking the remaining steps necessary to put the set into production. Since the functional and market design work had already been carried out, the first step was study of design to detect any features inconsistent with efficient manufacturing processes and suggestion of remedies if difficulties were found. This careful scrutiny was the work of engineers specializing in design and production of the type of apparatus to which the telephone handset belonged.

By training and experience, these men were especially fitted to discern changes or modifications in design which would facilitate production and ensure low costs. An important consideration in this study was interchangeability of parts. Tolerances had to be controlled to permit parts to be assembled interchangeably without sacrificing quality, and clearances were made large enough to permit assembly without trying or fitting. The greater the possible clearance between companion parts, the lower was the cost to manufacture. The effect of the design of parts upon the cost and life of tools was also studied in the interest of achieving design which would permit use of rugged tools and thereby eliminate interruption in production because of tool breakage or adjustment.

9. ILLUSTRATIONS OF IMPROVEMENT IN PRODUCTION DESIGN

An example of results obtained from such design study in the interest of manufacturing economy was a change made in parts of the cradle support for the handset mounting. In the design as originally submitted to the planning department, the screw bushing was specified to have a 32-pitch thread at the top, necessitating threading the entire length of the cradle stud and requiring about 28 turns in assembly. Engineers in the planning department, after obtaining design approval from the Bell Telephone Laboratories, changed this thread design to 24-pitch and moved it to the bottom of the bushing. As a result of this change, only 9/16 inch of the cradle stud needed to be threaded and the turns in assembling were reduced to about 15. In addition, it was easier to produce the coarse thread on the aluminum-silicon die casting from which this cradle was made, and to a large extent, the hazard of stripping in assembly was eliminated.

Another instance of design improvement was the redesigning of the plunger rod in the cradle, which operated the contacts in the base of the handset mounting. For bearing purposes, this rod had a shoulder on it near the cast head. The plunger stem was only 1/4 inch in diameter, but according to the original plans it was necessary to make the part from 3/8-inch rod in order to provide for the shoulder. Manufacture required a deep cut on a screw machine, which besides producing considerable scrap was a slow operation, especially since the rod was made of bronze. After having been cut, the rod had to be buffed to eliminate toolmarks and prevent sticking or sluggish action when the handset was lifted. This part was redesigned, the proposed bearing shoulder on the turned rod being replaced by a close-fitting sleeve. The change made it possible to use ¼-inch bronze rod, which could be purchased commercially with a satisfactory finish so that the only manufacturing operation necessary was to cut the rod to proper length. The sleeve was simple to make, and its manufacture did not cost so much as turning a shoulder on ⅜-inch rod.

10. PRELIMINARY COST ESTIMATES

When design had been thoroughly studied to ensure economy in manufacturing, the planning engineers prepared a preliminary cost estimate, the purpose of which was to aid executives in deciding whether the proposed apparatus was practical from the standpoint of the relation of costs to expected demand. In preparing the cost estimate, the planning engineers specified the operations to be performed on each part, the types of machines on which the parts would be run, and the anticipated hourly outputs. They then applied the standard burden and labor rates to these figures. The weight of material was determined and unit raw material costs were applied, which gave an approximate material cost for each part. The costs of all the parts were then added to the assembly and inspection costs to make up the total estimated cost of the set. These estimates were scrutinized by other engineering specialists on telephone apparatus to make sure that they were not inconsistent with the cost of similar apparatus already in production.

11. SETTING STANDARDS AND SPECIFICATIONS

After approval by these specialists and final authorization for manufacture by executives, the planning department made the manufacturing drawings. In addition to detailed drawings of each part, the engineers made a stock list of the kinds and quantities of the various parts required and drawings showing how the various parts were to be assembled. They also prepared manufacturing specifications covering mechanical and electrical requirements which the apparatus had been designed to meet. Further measures to ensure economical manufacture often were incorporated when these drawings were made; for example, at this stage in the development of the handset, savings were effected by changing dimensions of holes to permit them to be punched instead of drilled.

12. MANUFACTURING FACILITIES AND PROCEDURES

After the drawings were completed, final specifications were made for the kind and quantity of raw materials to be used. The actual operations of manufacture, assembly, and testing were defined, and tools, gauges, machines, and other equipment were decided on. In the selection of raw materials, consideration was given to the nature of the operations to be performed on them and the most advantageous sizes and quantities of materials to purchase.

Four main considerations were involved in determining the best manufacturing procedure. The first was the quantity of parts to be made and its effect on the grade of tools and equipment to be specified, and the possibility of using laborsaving devices, automatic machinery, and special raw materials. The second was the quality of parts and its effect on the quality of tools and rate of machine operation. The third was the expected permanency of demand and its relation to the economy of establishing most efficient methods at the start. The fourth was the safety of employees as it related to use of machines and tools, installation of proper ventilating equipment, and sometimes even wearing apparel.

The company maintained a perpetual inventory of machinery available for production and similar information for floor space and bench equipment. The planning department made use of this information when assigning machines for the manufacture of a new product. If machines of new design were required, they were ordered from a large machine-building organization and constructed under partial supervision of Western Electric Company, Inc. A large part of the company's production, however, was turned out on purchased machinery of standard type.

The company usually designed and built most of its tools. The tool-designing unit was a large group in the planning department, and the company toolrooms were equipped for large-scale production. Much had been done in standardizing designs, and the company maintained stocks of standard tool parts, making repairs possible with little delay and cost. Standard parts were used also in new tools, which often were a combination of standard parts and special new parts.

13. TESTING ORIGINAL PLANS

Since production generally was started on a smaller scale than was needed to fill later demand, the planning engineers had an opportunity to test their original plans in operation, to study the most economical processes and tools to use when production increased, and to improve on their original designs. When first put into production, the bakelite parts of the telephone handset, such as the handle and the outer cases for the receiver and transmitter, were molded on gas-heated five-platen presses. Single-compartment hand-operated molding dies were subsequently used, and as the demand increased, production was further facilitated and cost reduced by use of presses in which the dies were steam-heated and water-cooled and which opened automatically. As a further improvement, the development engineers on plastic molding developed a 250-ton press especially suited to the large-quantity production of these parts. Advantage was taken of the shape of some of the bakelite parts to design combination dies which produced two parts simultaneously, one lying within the other in the die.

14. PLANNING FOR LABOR

In the planning functions dealing with labor, use was made of job analyses, which the company's industrial engineers had prepared for every operation in the company's plants. Each of the thousands of manufacturing operations carried on had been analyzed and graded, and a symbol for it had been established. Each symbol represented a range of hourly pay rates, the minimum of which was the base rate. Every factor of each operation had been analyzed and evaluated from the standpoint of the operative and the company. Consideration had been given to the personnel requirements of the job, such as strength, skill, experience, alertness, nimbleness, responsibility, and accuracy, and such conditions as the monotony, strain, humidity, temperature, fumes, dirt, and hazards associated with the job. Consideration also had been given to the local supply of the particular kind of labor required, to local living conditions, and, for a class of work entirely new in the territory, to the rates required to attract at least a nucleus of trained personnel from elsewhere. At different plants, a given symbol carried a slightly different range of rates, fitting into the wage level of the territory. Final establishment of symbols was authorized by the vice-president in charge of manufacture.

Labor grades were used by the employment departments in hiring help, by the foremen as a guide in classifying the personnel of their organizations and in revising rates of pay, and by the planning departments in estimating labor costs of new products and in furnishing the base rates for the determination of incentive rates and control of costs. When the first labor grades were being set, every new job rate was compared with the corresponding rates of other companies, but later comparisons were mostly internal with only occasional outside checks, and it was usually found that even when new products were added the operations involved had already been graded. Records of labor turnover were classified to aid in reconsidering wage scales and making any revision necessary to meet fluctuations of the labor market and thus ensure an unbroken supply of labor of each class.

For the manufacture of the telephone handset, it was not necessary to set up new labor grades for each machine operation, since most of the parts were manufactured with standard equipment for which grades were available. Assembly of the apparatus, however, presented a large variety of labor requirements for which the planning department had to provide new grades.

The step following establishment of the new labor grades was to set up "time standards," or the standards of output which should be obtained by the average operative when a reasonable amount of effort was expended. Instead of making time studies of each operation, it was the practice of the industrial engineers of the planning department to make fundamental time and motion studies of the human and mechanical elements involved in each general class of work. For example, studies were made of drill-press work in general to determine what the constant and variable elements of such operations were, considering such factors as feeds, speeds, depth and diameter of holes, kinds of material, and weights and sizes of parts. Basic curves and charts were then developed in accordance with set formulas, which were used to establish piece rates or other incentives on any variety of parts within the range of work to which the standard was applicable. To obtain final rates there remained only a mathematical calculation, which often could be made by a technical clerk. Engineers could set final base rates for operations that had been analyzed without ever seeing the particular operation performed. Standards were being set to cover the entire range of the company's operations in manufacture and assembly of apparatus and equipment.

In manufacture of the telephone handset, the time standards were used as a basis of establishing incentive rates and standard costs and also in connection with figuring manufacturing capacity and calculating savings involved in cost reduction and manufacturing development studies.

15. DETERMINING WAGE PAYMENT METHODS

Following establishment of the appropriate labor grades and output standards, the final task of the planning engineers was to decide on the methods of wage payment most suitable for the operations. Setting incentives was complex because of the diversity of jobs performed. Experience of the company had shown that not all classes of labor worked to best advantage under one method of incentive wage payment. The planning department constantly reviewed and improved on existing methods, keeping in touch with developments throughout the country and abroad. The company used individual and gang piecework, calculated weekly, biweekly, or monthly; individual and gang premium; and several special incentive plans which were being tried experimentally. Incentive plans were applied to practically all routine and repetitive work in the manufacturing departments, and engineers were working on incentive plans for jobs that always had been on a time or salary basis.

16. SUMMARY AND CONCLUSIONS

In Western Electric Company, Inc., the organization for putting new products into production was more elaborate than is usually found in industry. The detail of preplanning was more thorough than for many companies. Nevertheless, this large organization was probably well worth the cost. It prevented serious mistakes. It enabled management to plan operations in general far ahead. It tended to ensure profits. The time required for the making of such thorough studies would not be available to companies whose market and competitive situations place a premium on quick action. Where speed is important, less preparatory work is possible, although the functions of the preparatory work are much the same. Design covers product function, market appeal, and production cost. In addition to product design, manufacturing specifications and standards of some degree of exactness must be set. The process of manufacture must be planned at least in its broad outlines, and provision for checking results must be supplied. Finally, production cannot get under way until the necessary facilities—plant and equipment, tools, materials, and labor—are at hand. Even the smallest business must go through this procedure when bringing out a new product. The more nearly the new item resembles an old one, the less difficult, expensive, and time consuming the preparatory work will be. The more radical the innovation and the more pressing the need for getting it on the market quickly, the more difficult will be the task and the more uncertain will be the results.

Preplanning and Personnel Control. The carrying through of product and production planning into the area of personnel control, as was described in the case of Western Electric Company, Inc., is rather unusual. More often this work is done in a separate personnel department.

The Western Electric procedure is subject to some risk. There is danger that the personnel work may become mechanical, too much an engineering type of treatment. This, of course, is contrary to the thesis developed in this text that the most important characteristics of the worker are his reasoning ability and emotional reactions. These characteristics are difficult to blend with slide rule and "log" table methods. Attempts at personnel control as an exact engineering science seldom have developed fully the potentialities of a work force. Planning department control of job standards, worker selection, wage payment methods, and wage rates need not necessarily become mechanical. There is risk that it may do so. Any such development should be guarded against very carefully.

Removal of job and wage control from the personnel department might adversely affect the ability of that department to function well in creating and maintaining labor relations. Many difficult problems in personnel relations have their beginnings in job and wage situations. To isolate control of these matters from personnel management would seem to make personnel relations difficult. Success of any one company in keeping these problems separate is not conclusive proof of the desirability of so doing. The wisdom of such separation as a usual practice is doubtful. It carries too many possibilities of trouble.

Product Improvement. Product development and new product planning are often the lifeblood of a business. The producer of games and toys is engaged in a business of that type. Some manufacturers are in an entirely different position, not so dependent on continually having new things to offer the buying public. The producer of portland cement is an illustration of this situation. However, every manufacturer must continuously seek product improvements. It is commonly assumed that this need is the result of constant consumer demand for better things. This is true in part only. It must be remembered that consumer desires and demands are shaped very largely by those who cater to them. A manufacturer will find it fully as important to consider constantly what his competitor may be about to offer the consumer as to consider what the consumer might rationally be expected to want. Too little attention is sometimes given the competitor and too great reliance placed on the consumer as guides to product improvement, development, and change.

QUESTIONS

1. Describe and explain the personnel employed in the product planning department of Western Electric Company, Inc.

2. Why was the product planning department of this company able in large part to ignore functional and market aspects of product design? What attention was given to these aspects of design?

3. What was the first step taken by the department when a new product was to be considered? What was the objective?

4. Cite some examples of design improvement in the case of the telephone handset.

5. What was the purpose of the preliminary cost estimates which followed initial consideration of product design?

6. What were the purposes of each of the functions 2 to 9 of the product planning department as listed on page 481 of the Western Electric Company, Inc., case?

7. Why does performance of these functions follow the sequence given in the case?

8. What are the advantages and disadvantages of placing control of job standards, worker requirements, wage payment methods, and wage rates in the hands of the product planning department, as described in the Western Electric Company, Inc., case?

9. Are the product planning policy and procedures of this company well suited to its needs?

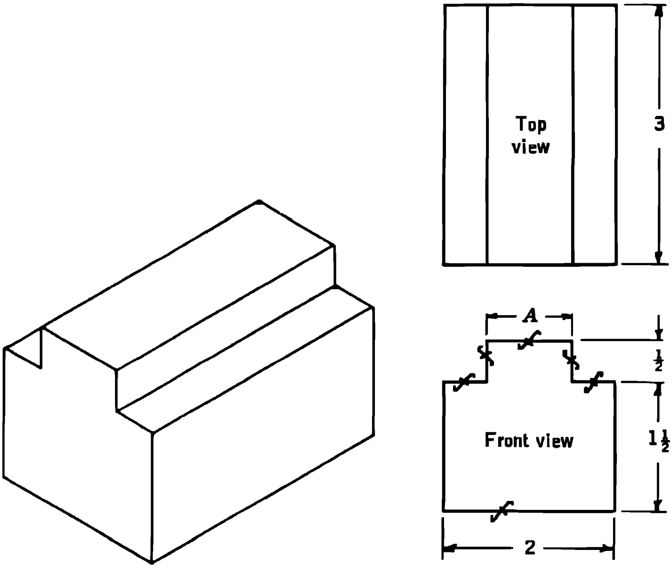
10. Would other companies find these methods suitable for their purposes?

PROBLEM 46 YORK-JACKSON COMPANY

The York-Jackson Company manufactured machine tools, such as light lathes, small milling machines, and shapers. To meet increasing competition, the company was redesigning many of the parts of these machines to make them easier and therefore cheaper to produce. One such part was a stopblock which was standard on all shapers. This block was made in three sizes.

The stopblock was a rectangular cast-iron block 3 inches long and 2 inches wide at the base. On its top was a raised bar that ran lengthwise of the block. This raised bar was ½ inch high. The stopblock was made in three sizes, which were specified as ¾ inch, 1 inch, and 1¼ inches. These dimensions referred to the width of the raised bar that ran lengthwise of the block. The three sizes of stopblock were exactly alike except for the width of this bar. Exhibit 1 is a sketch of the stopblock and a shop drawing of the design.

In the past the stopblock had been made by casting an iron block $2\frac{1}{8}$ inches wide, $3\frac{1}{8}$ inches long, and $2\frac{1}{8}$ inches high. All three sizes were made from the same size casting. The first machining operation was to make the bottom surface of the block flat. This was done by putting the block in a milling machine and passing it slowly beneath a rotating cutting wheel. Usually 20 blocks of one size were made at one time, and the first operation was performed on 20 castings before any other work was done on the block. The need for performing this operation is shown in the front view of the shop drawing of the part, Exhibit 1. The ƒ mark on the bottom line calls for machining that surface.



Picture sketch of stop-block
$\frac{3}{4}$ inch size

Shop drawing

Note:
Dimension *A* to be made
in 3 sizes
$\frac{3}{4}$ inch
1 inch
$1\frac{1}{4}$ inch

Exhibit 1. York-Jackson Company. Picture Sketch and Shop Drawing of Stopblock.

The next operation was to machine the top.[1] This also was done on a milling machine. Three cutting wheels were mounted side by side in the milling machine. Two of these cutters were the same size. The other cutter was 1 inch less in diameter and was exactly the width of the bar to be cut on the top, either ¾ inch, 1 inch, or 1¼ inches. The three cutting wheels were mounted side by side in the milling machine, with the smaller diameter wheel in the middle. It took about 20 minutes to mount the cutting wheels in the machine and to adjust them to make the proper cut. After the milling machine was set up, a cast block with its machined base down was passed under the revolving cutters. The two outside cutters removed the proper amount of metal on each side of the top of the block and left the raised bar. The third cutter, the one of smaller diameter which had been mounted between the two larger cutters, machined off the top of the raised bar. The width of the bar depended on the width of the smaller cutter in the middle. If the smaller cutter was ¾ inch thick across the face, the side cutters would be ¾ inch apart and the bar would be ¾ inch wide. If the middle cutter was 1 inch thick across the face, the bar would be 1 inch wide. If a 1¼-inch center cutter was used, the bar would be 1¼ inches wide. Whenever the width of the bar was changed, a new gang of cutters had to be set up in the milling machine. The time required to pass a block under the cutters for machining the top surfaces was about four times as long as the time required for the passage of the block under the single cutter used when the bottom of the block was machined. This was because much more metal was removed on either side of the raised bar when the top was machined.

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[1] See finish marks on top surfaces in front view of shop drawing, Exhibit 1.

A lot of 20 stopblocks of one size was machined each month. As three sizes of blocks were required, three lots were run each month. When a run was completed, the blocks were placed in the stock room from which they were withdrawn a few at a time as needed for assembly of shapers.

The inventory of finished stopblocks in stock was not allowed to go below 10 blocks of each size. This minimum inventory was necessary to take care of the replacement orders received from customers who had previously purchased shapers. The raised bar on the stopblock wore in use, and periodically stopblocks had to be replaced.

The company's design engineer proposed that the stopblocks be made differently. He suggested that the part consist of a rectangular cast-iron block 2 inches by 3 inches by 1½ inches high with the top and bottom machined flat. Two threaded holes would be made in the top of the block. The raised bar would be made separately and would be cut from 10-foot strips of cold-rolled steel bar stock which would be purchased ½ inch thick and in three widths: ¾ inch, 1 inch, and

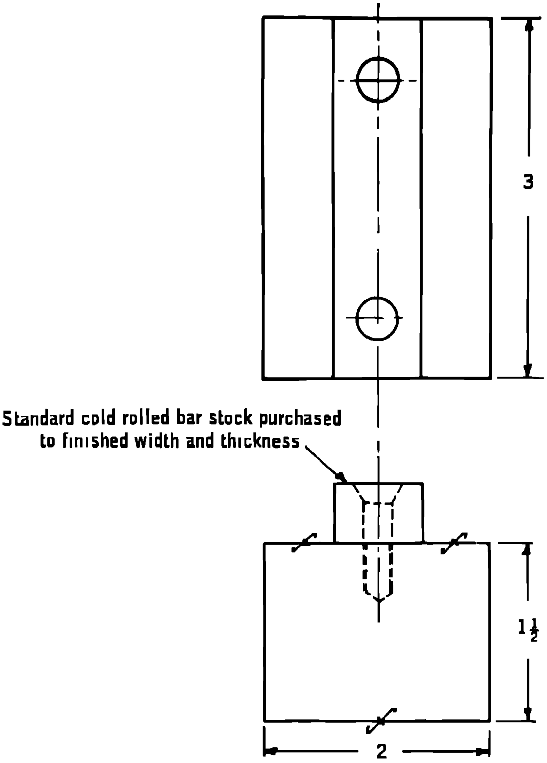

3
Standard cold rolled bar stock purchased to finished width and thickness
1½
2

Exhibit 2. York-Jackson Company. Shop Drawing of Redesigned Stopblock.

1¼ inches. The raised bar would be made by cutting off 3-inch lengths of bar stock of the proper width and drilling two holes in each 3-inch piece. These holes would correspond with the holes drilled in the cast-iron block. The steel strip would be assembled to the cast-iron block by means of two flathead screws. No additional machining would be required on the raised bar as the size and finish of cold-rolled bar stock would be adequate for the proposed use. Exhibit 2 is the shop drawing of the redesigned bar.

QUESTIONS

1. What are the advantages and disadvantages of the proposed new design?
2. Do you think the new design should be adopted to replace the old one?

PROBLEM 47 LEON CANNIFF COMPANY

The management of the Leon Canniff Company was experiencing difficulty in obtaining suitable dies. The problem was of a character not infrequently found in the relationship between the design and the production functions of companies manufacturing style goods.

The general manager of the Leon Canniff Company, which manufactured waterproof footwear, was called upon to settle a dispute between the style designers, who were under the supervision of the merchandising division, and several department heads in the production division. The question involved the adoption of a new type of die which was less thick than the dies ordinarily used in manufacturing the company's products. A suggestion to use a ¾-inch die, advocated by the style-design department, had been resented by several departmental officials in the production division on the grounds that the various production departments concerned were quite competent to decide what type of equipment should be used without advice from the style designers of the company. The general manager, after deciding that the new type of dies should be used when savings would result, asked the staff superintendent, an administrative assistant to the general manager, to review the company's procedure for die procurement and make recommendations as to the changes, if any, which he believed desirable in order to prevent future friction between departments in the merchandising and manufacturing divisions of the company.

The staff superintendent, after a considerable amount of inquiry, discovered that the procedure for die procurement was as shown in Exhibit 1. The steps involved were as follows:

1. One of the three style designers in the style-design department, after sketching a new style, took his sketch to a patternmaker assigned to him by the pattern-room foreman and explained to the patternmaker what he desired.

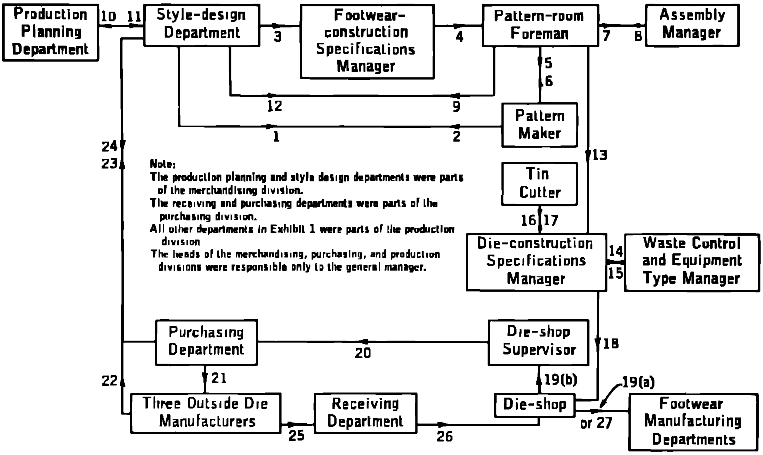
2. The patternmaker cut out paper patterns for a complete shoe as sketched and gave them to the designer.

3. The designer took the patterns to the footwear-construction-specifications manager who wrote mill instructions for the manufacture of the shoe.

4. The footwear-construction-specifications manager turned his written instructions and the patterns over to the pattern-room foreman.

5. The pattern-room foreman instructed one of the patternmakers in his department to make up a complete new set of patterns, one for each size of shoe to be manufactured, in accordance with the specifications.

6. The patternmaker turned over the complete new set of patterns to the pattern-room foreman.


Production Planning Department
10
11
Style-design Department
3
Footwear-construction Specifications Manager
4
Pattern-room Foreman
7
8
Assembly Manager
5
6
12
9
Pattern Maker
1
2
24
23
13
Tin Cutter
16
17
Die-construction Specifications Manager
14
15
Waste Control and Equipment Type Manager
Purchasing Department
20
Die-shop Supervisor
18
21
19(b)
19(a)
22
Three Outside Die Manufacturers
25
Receiving Department
26
Die-shop
or 27
Footwear Manufacturing Departments

Note:
The production planning and style design departments were parts of the merchandising division.
The receiving and purchasing departments were parts of the purchasing division.
All other departments in Exhibit 1 were parts of the production division
The heads of the merchandising, purchasing, and production divisions were responsible only to the general manager.

Exhibit 1. Leon Conniff Company. Procedure for Die Procurement.

7. The pattern-room foreman submitted this set of new patterns and construction specifications to the assembly manager, who arranged to have a pair of shoes in each size cut from the patterns and assembled in accordance with the construction specifications.

8. The assembly manager forwarded the completed sample shoes, the patterns, and the construction specifications to the pattern-room foreman.

9. The latter sent the sample shoes to the style designer.

10. The style designer after obtaining acceptance of the style by the merchandise manager submitted the sample shoes to the production planning department. The latter determined how many pairs of shoes in each size should be manufactured in the particular style and the date on which production was to begin.

11. The production planning manager informed the style designer of his decision regarding the date on which production was to begin.

12. The style designer informed the pattern-room foreman of the

acceptance of the pattern and of the day on which production was to begin.

13. The pattern-room foreman took a complete set of patterns to the die-construction-specifications manager and informed him when it would be necessary to have dies prepared.

14. The die-construction-specifications manager submitted the patterns to the waste-control and equipment-type manager, who decided by experiment just how the dies should be arranged for cutting purposes and what type of equipment should be used in the manufacture of the shoes.

15. The waste-control and equipment-type manager reported his decision to the die-construction-specifications manager.

16. The latter submitted the patterns to the tin cutter with instructions to make a complete set of patterns in tin.

17. The tin cutter made the patterns in tin and submitted them to the die-construction-specifications manager.

18. The die-construction-specifications manager then took the tin patterns to the die shop where they were turned over to a die maker.

19*a*. If the die maker was free to make the dies himself, he did so and sent them to the footwear manufacturing department.

19*b*. If he did not have time to make them himself, he so informed the die-shop supervisor.

20. If the die-shop supervisor decided that his department would be too busy to make the dies in time to meet the production date, he requested the purchasing department to buy the dies from outside manufacturers.

21. The purchasing department then awarded a contract for the construction of the dies to one of three outside die manufacturers.

22. The outside manufacturers, if not completely satisfied with the specifications submitted to them or if in doubt as to exactly what was required, so informed the purchasing division.

23. The latter then gave the manufacturers permission to approach the designer of the style of shoe for which the dies were being made.

24. The designer told the manufacturer exactly what was wanted for the particular style of shoe.

25. The die manufacturer prepared the dies and sent them to the receiving department of the Leon Canniff Company.

26. The receiving department forwarded the dies to the die shop.

27. The die shop forwarded the dies to the footwear manufacturing department where they were stored until they were to be used.

The style designers working according to this plan frequently found it necessary to make contacts with outside die manufacturers. As a result the designers often learned of new ideas in shoe design from the manufacturers who made waterproof footwear dies for Canniff competitors. Also, they received information regarding new types of die design. The controversy which existed between the merchandising and the production divisions was directly attributable to information concerning die designs which had been obtained by one of the style designers in a conference with an outside manufacturer.

The outside manufacturer had reported that a number of companies were beginning to use dies ¾ inch thick in place of the 1¼-inch dies previously used. According to the statement of the manufacturer, although these ¾-inch dies were not so durable as the 1¼-inch dies, they were considerably cheaper and quite satisfactory for styles of shoes which were not to be produced in large quantities. The style designer who had obtained this information immediately requested, in a note attached to the production order for dies for a new shoe style which had already been approved, that they be ¾ inch thick.

When, however, the order reached the die-construction-specifications manager, the waste-control and equipment-type manager, and the die-shop supervisor, all three resented what they believed to be an attempt on the part of the merchandising division to tell them how to run their business and insisted that 1¼-inch dies be made. The style designer, after being informed that his suggestion had not been followed, appealed through the merchandise manager to the general manager, stating that the production division was reluctant about making changes or adopting new ideas. He asked for authority to negotiate directly with outside manufacturers for the purchase of ¾-inch dies for trial purposes. The general manager granted this request on the grounds that it was necessary for the company to keep abreast of the times, in spite of resistance from the superintendent of the production division, who supported his subordinates' contention.

The general manager stated that if the production division was right and the style designer wrong, use of the dies would prove the production division's claim that the ¾-inch dies would not stand up under use. The purchased ¾-inch dies, when used, proved to be wholly satisfactory, and the general manager instructed that they should be used thereafter whenever savings would result.

Immediately thereafter the style designer who had discovered the economy of ¾-inch dies sent a production order for dies for a new style to the production department with a note stating his belief that ¾-inch dies would be best for the pattern. When this suggestion reached the die shop, the supervisor reported that the costs of the ¾-inch dies were too great to justify their use. The style designer again appealed to the general manager, stating that the production department was continuing to be stubborn in regard to the use of ¾-inch dies. The general manager then asked the die shop supervisor to submit costs for the ¾-inch dies. The supervisor attempted to learn what the costs of purchasing such dies from outside manufacturers would be, first, from the purchasing agent, who did not know since he had purchased none in the past, and finally, from the style designer, who refused to tell him. He then made up and submitted an estimate of costs which proved to be considerably above that for which outside manufacturers were willing to deliver dies to the company. The general manager informed the die-shop supervisor that his estimates were out of line and asked whether his department was inefficient or whether his estimates were high. The supervisor then revised his estimates of costs downward to a competitive level.

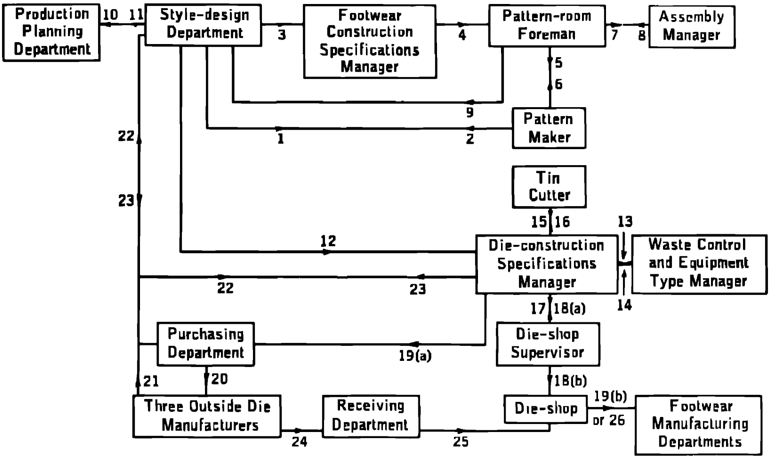

Production Planning Department
10
11
Style-design Department
3
Footwear Construction Specifications Manager
4
Pattern-room Foreman
7
8
Assembly Manager
5
6
9
Pattern Maker
22
1
2
23
Tin Cutter
15
16
13
12
Die-construction Specifications Manager
Waste Control and Equipment Type Manager
22
23
17
18(a)
14
Purchasing Department
19(a)
Die-shop Supervisor
21
20
18(b)
19(b)
or 26
Three Outside Die Manufacturers
Receiving Department
Die-shop
Footwear Manufacturing Departments
24
25

Exhibit 2. Leon Canniff Company. Proposed Procedure for Die Procurement.

The general manager believed that it was essential to have someone in the company in a position to obtain information concerning developments in die and footwear design from outside manufacturers. In his opinion, however, the friction already brought about in the procedure for die procurement as set up in the Leon Canniff Company would offset to a considerable degree the benefits from outside advice received through the style designers.

In response to the general manager's request the staff assistant recommended that the procedure shown in Exhibit 2 be adopted. Study of Exhibits 1 and 2 shows that the following changes were recommended:

1. The function of the pattern-room foreman as an intermediary between the style designers and the die-construction-specifications manager was abolished (steps 12 and 13 in Exhibit 1), and direct communication between them was established (step 12 in Exhibit 2).

2. The die-construction-specifications manager was to address requests for die manufacture to the die-shop supervisor (step 17 in Exhibit 2), rather than to the die makers (step 18 in Exhibit 1).

3. Future requests of the purchasing division for dies to be purchased from outside manufacturers were to be made directly by the die-construction-specifications manager (step 19 in Exhibit 2), instead of by the die-shop supervisor (step 20 in Exhibit 1).

4. When outside manufacturers requested additional information or suggested that changes in dies be made (step 22 in Exhibit 1 or step 21 in Exhibit 2), the purchasing agent was to arrange for discussion between the manufacturer and a committee composed of the particular style designer, the die-construction-specifications manager, and himself. This arrangement (steps 22 and 23 in Exhibit 2) was to replace the existing procedure by which the manufacturer communicated directly with the style designer only (steps 23 and 24 in Exhibit 1).

QUESTIONS

1. Compare conditions in the Leon Canniff Company with those in the Western Electric Company with respect to:
   a. Problems of product design
   b. Problems involved in the introduction of new products into manufacture

What problems do these companies have in common? At what points and in what ways are their problems dissimilar?

2. Compare the York-Jackson Company and the Leon Canniff Company as to problems of communication in the areas of new product design and introduction of new products into production.

3. Should the recommendations of the assistant to the general manager of the Leon Canniff Company be approved?

4. If you think the assistant's proposal should not be adopted, what changes, if any, would you recommend?

19

CONTROL OF THE PRODUCTION PROCESS

BELMONT JEWELRY COMPANY (A)

1. A DEPARTMENT MANAGER INSTALLS RECORDS AS A BASIS OF PRODUCTION CONTROL

Production in the pin and coat-of-arms department of the Belmont Jewelry Company had been lagging behind schedule. A new superintendent was obtained for the department, and the president of the company made him responsible for improving conditions in the department. The superintendent requested that he be permitted to install records as the first step in a system of production control.

2. THE PLANNING FUNCTION OF MANAGEMENT

In Chap. 2 four functions characteristic of all managing were described. The first of these was planning. This function ranges from the determination of over-all company objectives and long-range planning to the development of short-range, even day-to-day and hour-by-hour schedules. The determination of corporation objectives and policies is the responsibility of top executives. Short-range plans and schedules usually are the work of supervisors in the lower echelons of the organization. This chapter is concerned with these more detailed planning responsibilities.

3. PLANNING AND SCHEDULING AS A MANAGEMENT PROBLEM

In the factory the supervisory control task is of two parts, planning the work and then controlling its execution. For convenience, planning may be subdivided into two divisions. The first includes problems of how to make the product, when to make it, and how much to make at one time. This division is commonly spoken of as master planning or frequently merely as planning. The second part, routing and scheduling, includes the assignment of work to departments, the designation of equipment and men for specific tasks, correlation of the various steps in the processing of parts, and regulating the assembly of parts into finished product. Master planning and scheduling together have as their function the getting of a product into production and follow-up throughout the process.

4. OTHER PROBLEMS OF CONTROL

Planning and scheduling are but a part of the manager's production responsibilities. There are raw materials to be supplied and controlled. The entire producing personnel requires supervision. Machines and equipment must be serviced and kept in repair. A dependable source of power must be ensured at all times. Plant conditions such as light, heat, ventilation, and sanitation need continuous control. Quality is always important and is frequently a source of much trouble. These and many other problems constantly call for supervision if waste is to be controlled. And, finally, through all, and usually above all, costs demand unceasing supervision.

5. MAGNITUDE OF THE PLANNING AND SCHEDULING FUNCTIONS

The present chapter will confine itself to planning and scheduling. A very simple illustration will serve to demonstrate something of the magnitude of these tasks.

A child's toy, a miniature vacuum carpet cleaner, was sold in a department store for 69 cents. It is likely that the store paid the manufacturer 20 cents to 30 cents less. In appearance, the toy was a faithful reproduction of one of the best known, nationally advertised cleaners. It was about one-quarter the size of the original, was substantially built, and attractively finished.

Analysis of the toy revealed the following parts:

Parts stamped and drawn from sheet metal:
  1 motor housing
  1 fork for attaching handle
  1 upper part of cleaner housing
  1 lower part of cleaner housing
Wood parts—turned:
  1 handle
  2 wood wheels, one at each end of cleaner brush
  1 double wood wheel at rear of carriage
Cloth parts:
  1 dust bag
  1 elastic strap for attaching bag to handle

Other parts:
- 1 round wire brush
- 1 pin to form axle for rear wheel
- 1 screw hook for attaching cleaner bag strap to handle

This made a total of 13 parts, the production of which involved various processes.

The sheet-metal parts were first stamped out on a press using dies especially made for the purpose. Different sets of dies were required for each of the four parts. After these blanks had been stamped out, they were drawn and pressed into required shape by means of another set of specially designed tools on presses. The shaped parts were then finished by dipping. The motor housing was finished in black, the three other sheet-metal parts in silver gray. The production of each of these parts thus called for at least three operations, a total of 12 operations for the production of this first group of parts.

The handle was turned on a lathe, sanded, and dipped. The wood wheels at the ends of the brush were made by turning a rod of the desired diameter and then cutting it into the required segments to form the wheels. Holes were made in the centers, and the wheels were then dipped to give them a black finish. Two of these wheels were required for each toy. The rear wheel was similar except that it was larger and had a groove cut about its circumference midway between the sides. The production of these wood parts involved 16 operations for each cleaner.

The manufacture of the dust bag involved cutting two pieces of cloth to proper shape, hemming one end of each, sewing the two pieces together along their other edges, turning the resulting bag inside out, and stamping the name of the cleaner on one side of the bag. At the closed end of the dust bag an elastic loop was sewn. Eight operations were involved in the production of this part.

The three other parts were purchased from concerns which specialized in the type of part required.

Assembly of the 13 parts needed for each toy was accomplished in 12 operations. The motor housing was attached to the upper part of the cleaner housing by inserting lugs on the motor housing through slots in the cleaner housing and then bending the lugs over. The rear wheel was attached to the lower housing by placing the wheel between the two rear supports, slipping the pin through the holes, and pressing a head on the unheaded end of the pin. A wheel was next slipped over the projecting axle wire at each end of the round brush, and the three parts thus assembled were snapped into place in holes provided in the sides of the lower part of the cleaner housing. The upper and lower cleaner housing subassemblies were then put together and fastened in place by bending lugs after they had been inserted in corresponding slots. The dust bag could then be attached to the cleaner by slipping the open end over the projecting ring at the rear of the housing assembly and flanging this ring to hold the bag in place. The wooden handle was fastened to the handle fork by closing tight in a press, a metal band designed to hold the handle in place. The fork could then be snapped into place on the cleaner housing and the elastic band caught over the hook, which previously had been screwed into the handle, and the toy was completely assembled. The entire assembly operation involved a dozen separate steps, and the production of parts and assembly required 48 operations.

Controlling the production of 35,000 to 50,000 units of this simple toy in lots economical in size, yet satisfactory for delivery needs, required planning of tools, supplying of raw materials and parts purchased outside, scheduling of parts production of a half million pieces, each requiring several operations for its production, and assembly of these parts into finished product. The total cost for raw materials, purchased parts, labor, and factory burden must not exceed 23 cents per finished toy. Preferably it should be kept less than that.

In the meantime this same plant was producing scores of other more or less unlike products, each presenting its own numerous problems of production control.

Manufacturing plants do not operate themselves. From the time the production of some certain article is proposed to the time it is on the shipping dock, constant supervision calling for the making of scores of decisions is involved. The problem of scheduling the production of a toy vacuum cleaner is a simple one as compared with the scheduling job required to make a real electric cleaner with its stamping, drawing, casting, forging, machining, finishing, polishing, and winding, and much more intricate raw materials and assembly problems. The household vacuum cleaner is likewise a simple product as compared with an automobile, a steam locomotive, a 50-story office building, or a battleship. Even for relatively simple products the work of planning, scheduling, and checking of progress can be complex. The factory manager of a large brass fabricator in Connecticut says that in his plant over 5,000 different items regularly are in production at one time.

Complex as the planning and scheduling jobs seem to be, in the case of repetitive production they usually can be reduced to a few fundamental steps which permit operations to proceed in orderly fashion to the accomplishment of definitely predetermined results. The following experience of the Belmont Jewelry Company is more or less typical of process control problems and their solution.

6. NATURE OF THE BUSINESS

The Belmont Jewelry Company specialized in the manufacture of fraternity and sorority pins and badges, all kinds of jewelry with college and fraternity seals, stationery and calling cards, and dies for coats of arms. The business, by its nature, was highly seasonal, the heaviest sales being made just prior to the holiday season, the fraternity pledging, and college graduation periods. All production was for order, and the orders were usually small. This meant that great confusion was experienced in various departments during peak periods because of the multiplicity of small orders. There were approximately 20 firms operating in the industry, so that competition was keen and prices varied from time to time.

7. THE LACK OF RECORDS

Although the company was 15 years old, little had been done in the way of records, but the president had justified the situation on the ground that rapid growth of the company had necessitated centering attention on problems of actual production. In spite of the fact that the records were meager, it was obvious that the company was profitable and that its business was continuing to grow.

8. NEW DEPARTMENT MANAGER WISHES TO INSTALL A SYSTEM OF PRODUCTION RECORDS

Recently in the pin and coat-of-arms department, which was one of the six production departments, there had been much confusion, and production had been retarded. Two men of equal rank had been trying to operate the department, and, because of conflicting ideas, production activities were muddled. The president of the company, to iron out the difficulties, hired a new man, with considerable experience in similar businesses, to take charge of the department. The first request of the new department manager was for the records of the past performance of the department so that he might see where mistakes had been made and plan a campaign of reorganization. The president explained that the records desired had never been kept because the various executives and department managers had concentrated their attention upon solving production difficulties. The new department head was under the impression that one of the causes of the confusion in the pin and coat-of-arms department was the lack of records and that he could not iron out his difficulties if he did not have records. Although the president was anxious to "straighten out the production problems first," he said that the new manager was to be responsible for the department to which he was assigned and that it was up to him to get results. To accomplish this end the new manager could do whatever he wished.

9. A TEMPORARY SYSTEM IS DEVISED AND TRIED OUT

Realizing that he had nothing to go on and that he would have to build from the ground up, the new department head worked out a simple system of production control which was to serve temporarily until experience could be made the basis for a permanent organization.

The manager knew that the largest item of raw materials was gold (sheets and wire). Occasionally pins and badges were ornamented with small jewels, but for the bulk of the output gold was the only raw material of importance that needed control, and to that extent the situation was relatively simple.

The multiplicity of small orders, however, presented a more difficult situation. The work was all by special order, and it was imperative that delivery promises be kept. It therefore seemed necessary that control devices regulate the putting of each order into process at a time such as to ensure its completion on schedule and that continual follow-up of each order during the manufacturing process be provided. At the same time the system for control had to be most simple, since otherwise its cost would be entirely out of proportion to the savings effected.

The extent to which the temporary method devised by the manager conformed to these requirements while serving its purpose can best be shown by explaining the system as it was in operation. The following is a description of a typical order from the time it was received in the general office to its completion for shipment.

10. HOW THE SYSTEM OPERATED

On April 16, the sales office had received an order for 40 class pins similar in design to an order made up the previous year (design number 6130) except that the enamel specified in the new order was to be blue whereas that of the previous year had been red. Also, the engraved numeral on the pin was different. Delivery had been promised for May 18.

As the design and specifications for the pin were already in the company's file and last year's dies were stored, it was only necessary to make the changes in specifications noted and the order was ready for issuance to the pin department, where it was to be made up. From the recorded experience of the previous year the production order clerk in the plant manager's office knew that nine days would be sufficient time for the processing of the order. Wishing to provide a certain margin for delays, the clerk on May 2 issued to the pin department production order number 742 covering this job. The production order gave all information necessary to enable the pin department superintendent to make up the order. The production order was accompanied by a copy of the design drawing and corrected specifications for the pin.[1]

Because work in his department was pressing, the superintendent did not put order number 742 into production until May 6. At that time, his assistant made out a job ticket[2] covering the work (see Exhibit 1, page 506). This ticket was the record upon which all process control was based. The assistant knew from experience the amount of gold required for the job and made out a requisition on the storeskeeper for it. He then detached coupon 1 from the job ticket and filed it for his future reference. He clipped together the balance of the job ticket, the design drawing and specifications, and the materials requisition and gave them to John Sawyer, the workman who was to perform the first operation on the order. Sawyer had just returned an order upon which he had completed his operation; therefore the new job was issued to him with instructions to start work at once.

Before beginning work, Sawyer obtained the necessary raw materials and entered his name and number, the date, and the time of starting the work on coupon 2 of the job ticket. When he had completed the operation some hours later, he entered the finishing time on coupon 2, and called an inspector. The inspector checked the quality of the work, entered the number of good units upon which that operation was O.K., and signed his name on the coupon.

Had any of the work been improperly done or had an insufficient number of pieces (as called for on the job ticket) been made up, the

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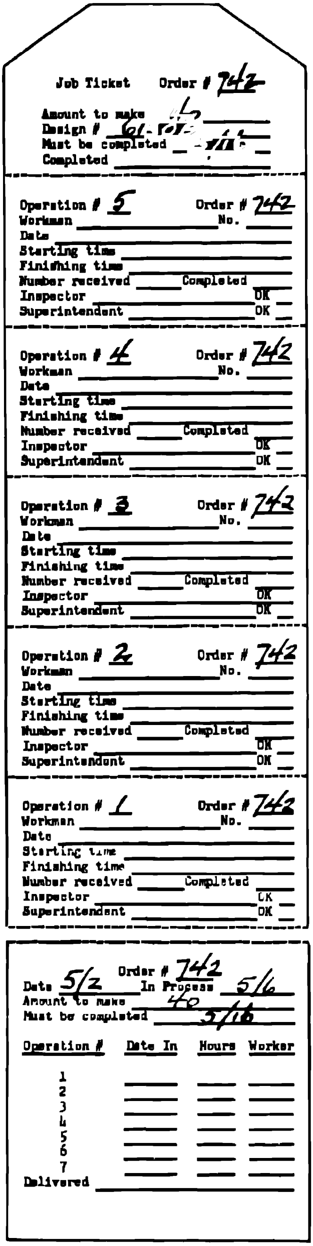
[1] The procedure outlined in this paragraph had been followed by the company for some time, and the new department manager saw no reason for changing it.

[2] The portions of the job ticket filled in by the superintendent's assistant at that time are indicated in the form in Exhibit 1.



Job Ticket Order # 742

Amount to make 40

Design # 61-[illegible]

Must be completed 5/16

Completed

Operation # 5 Order # 742

Workman No.

Date

Starting time

Finishing time

Number received Completed

Inspector OK

Superintendent OK

Operation # 4 Order # 742

Workman No.

Date

Starting time

Finishing time

Number received Completed

Inspector OK

Superintendent OK

Operation # 3 Order # 742

Workman No.

Date

Starting time

Finishing time

Number received Completed

Inspector OK

Superintendent OK

Operation # 2 Order # 742

Workman No.

Date

Starting time

Finishing time

Number received Completed

Inspector OK

Superintendent OK

Operation # 1 Order # 742

Workman No.

Date

Starting time

Finishing time

Number received Completed

Inspector OK

Superintendent OK

Date 5/2 Order # 742 In Process 5/6

Amount to make 40

Must be completed 5/16

Operation #	Date In	Hours	Worker
1			
2			
3			
4			
5			
6			
7			

Delivered

Stub stays with the job until completion.

Coupon 6

Coupons 6 to 2 are filled out by workmen and turned in to the department office as operations are completed.

Coupon 5

Coupon 4

Coupon 3

Coupon 2

Coupon 1

Coupon 1 is detached and retained in the departmental office to record progress of work through the department.

Exhibit 1. Belmont Jewelry Company. Job Ticket as Made Out by the Superintendent's Assistant.

inspector would have required that Sawyer rectify the error before the inspector approved the job by signing coupon 2.

Upon completion of the work, Sawyer took it and all records covering it to the department supervisor's assistant and received another job. The clerk initialed the coupon covering operation 1 (coupon 2) for the superintendent, detached it, and dispatched the job to the workman who was to perform the second operation as soon as that workman was available. From the information on coupon 2, the clerk entered the date completed, the number of labor hours applied, and the workman's number opposite the proper operation number on coupon 1, which was always retained in his file.

This procedure was followed for all five operations necessary to complete the job. Throughout the process, the job ticket remained with the worked material. Each time an operation was completed, the proper operation coupon, completely filled out and signed, was detached and made the basis of entry on coupon 1. Upon completion of the order, the date of completion was entered on both coupon 1 and the job ticket stub. The finished order, with the job ticket stub still attached, was sent to the shipping room, and the production order clerk in the plant manager's office was notified.

11. SUMMARY AND CONCLUSIONS

Results of the Temporary System. By means of the temporary procedure here outlined, the work of the department was greatly improved. The confusion of the past was eliminated; work was put into process in orderly manner and completed on time. Delivery dates were met, and the president was well satisfied with the work of the new department manager. The cost of the system was relatively small. The cost of forms was limited to the job tickets, and clerical work required only a portion of the time of the department clerk. It was estimated that the additional clerical work equaled not more than half the time saved for the department workmen, since they no longer had to wait for work assignment upon the completion of one job before beginning another.

Improvements Resulting from Experience. As the system was used, certain improvements were effected. It was found advisable to relieve the workmen of the task of filling in the operation coupons. This work could be done more quickly and accurately by the department clerk at the time the jobs were issued and returned. Later the several operation coupons were consolidated into one coupon which retained the same information given on the several coupons.

Individual coupons had been forwarded by the department clerk to the accounting department, where they had been used with the time-clock cards for payroll make-up. A simple uniform system of daily departmental labor reports had been put in force for the entire plant. After that the separate coupons were unnecessary, and when the next lot of job tickets was ordered from the printer all operation coupons were printed as one consolidated coupon.

At that time one other change was made, two more items of information being added to the job ticket stub. They were the time of beginning the first operation and total time required for processing. After a completed order was invoiced and shipped, the job ticket stub was forwarded to the production order clerk in the plant manager's office. The additional information included on the stub made it possible for him to use it as the basis for determining the length of time required for the production of future similar orders. The efficiency of his planning was thereby increased.

Reasons for Success of the System. The satisfactory operation of the plan seems to have been due essentially to the fact that it was devised by a man thoroughly familiar with the particular problems it was designed to control. In other words, the system was built up specifically to fit the particular conditions of operation, and no attempt had been made to adapt some preconceived method of control. For example, the small physical size of each job made it easy for the workman to transport the job itself to and from the clerk's office between each operation. By so doing, the use of more or less complicated systems of move orders and work assignment was made unnecessary.

Simplicity seems to have been the keynote of the whole plan. There was no attempt to provide a routine of paper work to control occasional departures from usual practice. The handling of such situations was left entirely to the personal attention of the department superintendent or his clerk. The relatively small size of the department made this entirely practical and much more advisable than any paperwork system designed to cover departures from usual routine.

The suitability of the system and its simplicity largely accounted for its success as a device for regularizing operations. These characteristics were likewise responsible for the low cost of its installation and maintenance.

Complexity in Production Control. Not all production control procedures can be as simple as that of the Belmont Jewelry Company. When a company makes a variety of products, some in large and some in small quantities, using a single set of machines for the production of all items, the process of control of work flow can become very complex indeed. Each product item must be produced to meet certain delivery requirements. It is desirable to minimize the time period from the start of work on an order until its completion. The shorter this production cycle, the less capital there will be tied up in the work in process, and the more effectively will each inventory dollar work for the company. Production control will seek to keep every machine in the plant operating productively as much of the time as possible. Money invested in idle machines usually is not producing profits. Each worker must be kept busy; otherwise, wages are a drain on potential profit. The longer a machine runs in producing an item without having to be set up to produce a different part or product, the lower will be the cost of machine setup for each item produced. At the same time long machine runs in the interest of minimizing setup costs should not be such as to increase product inventories excessively. Unneeded inventories represent nonworking capital and incur a variety of ownership and storage costs. This balancing of gains from long runs against ownership and storage costs is universally recognized as the "lot-size" problem.

Another approach to minimum machine setup costs is to arrange a series of change-overs on a machine so that the minimum amount of setup change is required between each item run. If a spray-painting machine is used to apply several colors, usually it is best to run the lightest color first and the darkest color last, with the other colors sequenced in between from light to dark. If this is done the time required for cleaning the machine to go from one color to another will be less than if the sequence starts with the darkest color, with the lightest color being run last. If the various colors are scheduled to the machine at random, the down time of the machine will exceed the time required to make the same changes carefully sequenced with respect to clean-up time between colors. Similar attention is important in most situations where a variety of products is produced on general-purpose machines.

Mechanization of the Control Process. Thus the problems of routing and scheduling in a manner that will give due considerations to a variety of influencing factors often is very complicated. Mechanization of such work using modern electronic devices and mathematical methods has become a great aid. The computer and linear programming in job machine shops and job printing plants can reduce machine down time and speed up deliveries greatly. There is much reason to believe that job machine shops using mechanized scheduling and routing will increase in size substantially. In the past the complexity of control in the job machine shop has tended to restrict the size of many such shops. Automation of the control process will enable these shops to increase the volume of work obtained from a given set of machines. It will also permit the economical use of a much larger number of machines than it has been profitable to try to control without the aid of modern electronic equipment. Efficient machine loading and operations scheduling now is not only practical in large manufacturing plants, it is much less costly as a control process than was control before these modern methods were available.

Of course machine control of manufacturing processes never is better than the quality of the information fed to the data-processing equipment. New human skills of a higher order are necessary. This is not an insurmountable obstacle. There is reason to believe that the use of electronic control for shop routing and scheduling will increase and that economical equipment will become available for use in relatively small manufacturing plants and shops.

Types of Production Control. This chapter has focused on one type of control situation only, production of a variety of products using general-purpose equipment, common to all the products produced. This is inherently a difficult type of control situation. In continuous process production, in automated and line-type production, in plants where equipment is arranged to produce only one or a limited number of items, the problem, though important, tends to be less complex. Sequencing of operations often can be predetermined by the selection and placement of equipment; thereafter the work flows without constant and current control procedures. Scheduling over a sequence of machines may consist simply of ordering that the equipment be run for a certain period of time or until a certain volume of output has been attained. An embracive treatment of the many and varied problems centering around control of the production process is beyond the scope of this text. This chapter only touches on the basic problems commonly involved.

QUESTIONS

1. What, in your opinion, had been the trouble in the pin and coat-of-arms department of the Belmont Jewelry Company?

2. What seems to have been the reason for failure to get out production in time to meet promised delivery dates?

3. Describe the control system temporarily installed by the new department manager. Be prepared to explain the purpose and importance of all records and procedures involved.

4. Explain the results of the installation of the temporary system.
5. What changes were made in the system? Why was each made?
6. What justification is there for the conclusion that the success of the system was due in considerable measure to its simplicity?
7. Why was it possible to have a system simple yet effective?
8. Should there have been a more formal control over the issuance of raw materials?
9. In general, what are the practical requirements of a system to control production scheduling successfully?

PROBLEM 48 BENNING ELECTRIC COMPANY

Benning Electric Company officials had devised a simple method of controlling volume of raw materials supplies and work in process. Control was facilitated by means of two simple graphs.

The Benning Electric Company manufactured five standard electric products: toasters, irons, radiators, ranges, and pads. The company manufactured these products for stock in accordance with schedules set by the general manager. The schedules specified the total number of each kind of product to be made by a certain date. For example, the schedule for toasters which was delivered to the factory superintendent on January 1 called for a total of 30,000 toasters to be made by July 1. Revisions were made in the schedules whenever warranted by business conditions; in practice, the schedules for each product were changed or extended two or three times a year.

The company controlled manufacturing operations by means of two sets of graphs: one set to control raw materials supplies, and one to control work in process, illustrated here by Exhibits 1 and 2, respectively. A raw materials graph and a production graph were prepared for each of the five products.

The raw materials needed for the manufacture of a particular product were listed on the left-hand side of a sheet of coordinate paper. Across the top of the sheet were listed the days of the month and the quantities of the product scheduled to be completed on those days. Whenever any raw material was received, a horizontal line was drawn on the graph opposite the name of that raw material, the length of the

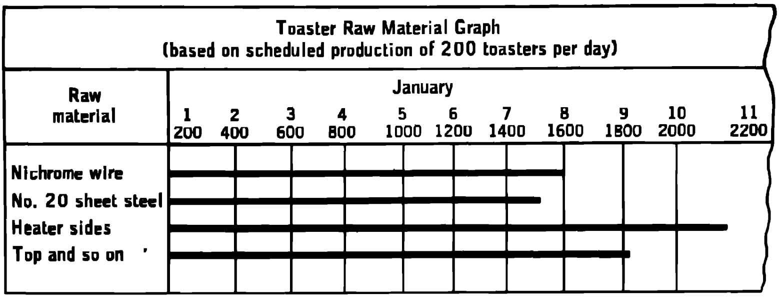


Exhibit 1. Benning Electric Company. Type of Graph Used to Control Supplies of Raw Materials.

line showing the quantity received in terms of finished product. Thus, in Exhibit 1 the line after "Nichrome wire" does not indicate that 1,600 feet of wire had been received, but that enough had been received to make 1,600 toasters. The total length of the line shows, in terms of finished product, the wire received since the beginning of the schedule. By referring to the date over the end of the line, and the current date, the executives could see how many days the supply of that raw material was behind or ahead of the schedule.

The total number of items listed on these raw materials graphs was about 300. The graphs were given to the planning supervisor, who, acting upon information drawn from them, made a report each month to the purchasing agent showing the requirements of each item for the month to follow. This report served as a purchase requisition.

Coordinate paper was used also for the five production graphs. On

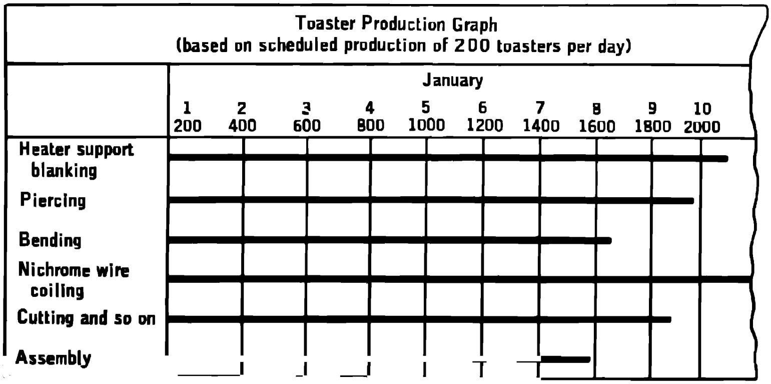
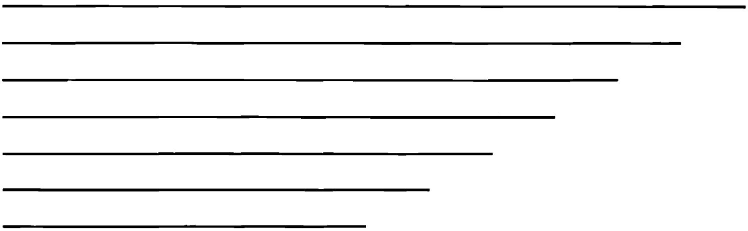


Exhibit 2. Benning Electric Company. Type of Graph Used to Control Work in Process.

the left-hand side of each of these graphs were listed the operations necessary to the production of the constituent parts of the product, *i.e.*, the most important or key operations. The number of these varied for the different products from 15 to 75. The last operation listed on each graph was the assembling of the product.

Across the top of each sheet were listed the days of the month, with the corresponding number of units of product to be completed on each date according to the schedule. From daily reports showing the number of parts finished, lines were drawn opposite each operation listed, so that the total length of the line for any operation showed the number of units on which that operation had been performed since the beginning of the schedule. All operations performed were expressed in terms of finished product, regardless of the number of pieces required per unit of product. Consequently, the lengths of the different lines could be compared directly. Thus, if a certain operation was completed on 500 sides, of which there were two for each toaster, the line for that operation would be drawn to represent 250 units, or enough sides to make 250 toasters. The relation of scheduled production to actual production was apparent from a comparison of the date over the end of the assembly line and the current date. The lengths of the other lines showed the quantitative status of the constituent parts, in relation to each other and in relation to the schedule.

These graphs also were kept by the planning supervisor, who, acting on the basis of the information they contained, issued production orders to the factory. The relative frequency with which he issued production orders for different parts and the size of the lots ordered varied with the conditions surrounding each part. Thus, one part he ordered every 3 days in lots of 600, and another every 10 days in lots of 2,000. In order to maintain uninterrupted assembly of finished product, it was his aim to keep the lines at the top of the sheet, representing the first operations, longer than the lower lines. If a perfect balance was maintained, the lines on the production graphs would look like this:



When the planning supervisor issued a production order, a light cross was made on the proper graph opposite the item affected at the point to which the line would reach when the order was completed. Thus, on the production graph in Exhibit 2, if a production order for enough heater supports for 300 additional toasters was issued, a cross would be made opposite the words "Heater support" under the figure 2,300.

QUESTIONS

1. What records were maintained to control manufacturing operations of the Benning Electric Company?
2. Describe the method used to control raw materials inventories and purchases.
3. How would you go about it to supply the information needed to maintain this graph?
4. Describe the method used to control work in process.
5. Would this method be satisfactory as a process control method for the Belmont Jewelry Company? Explain.
6. Were the raw materials and process control methods of the Benning Electric Company suitable and adequate for that company's needs?

PROBLEM 49 CORPORAL MOTOR CAR COMPANY (B)

The Corporal Motor Car Company installed a control tower to handle all scheduling of its automobile repair work. After a year and a half's experience with the control tower in operation, the management of the garage was satisfied with the results of the installation and felt that it had contributed a great deal to the effectiveness of the repair-work scheduling.

The Corporal Motor Car Company was located in Cambridge, Massachusetts, and combined a new-car sales dealership with its automobile repair service. Exhibit 1 shows the floor plans of the garage. The service division usually was handling between 65 and 75 cars per day that were in the shop less than 24 hours. In addition there were

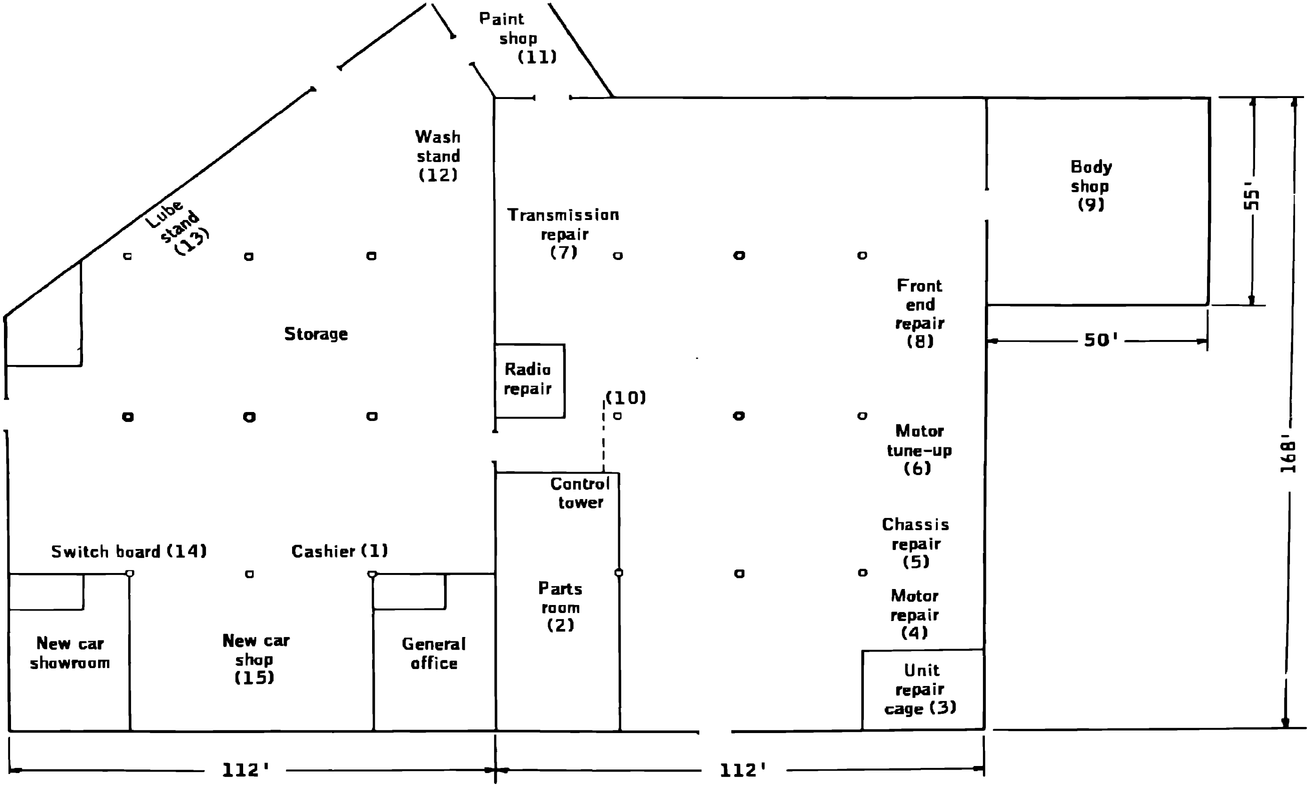


Exhibit 1. Corporal Motor Car Company (B). Diagram of Garage Layout. Numbers indicate speakers connected with control tower. Dotted line indicates path of message conveyor.

20 to 30 cars in the shop at all times for major repair work that lasted from two days to three months. The amount of repair work was subject to considerable random daily variation in volume and some seasonal variation, with the summer being the busiest season. The charges to the customers on every repair job were divided into labor, parts, and supplies, such as gas, oil, and accessories. The service division billed labor charges of $20,000 to $25,000 a month.

The service division employed about 30 people in the following categories: five service salesmen, eleven general utility mechanics,[3] one radio repairman, two grease-stand operators, one washstand operator, three body repairmen, four painters, one automatic-clutch repair specialist, one control-tower operator, and one car jockey. One of the body repairmen and one of the painters were designated as lead men in their respective shops. Each service job on any model of automobile had been assigned a standard labor charge. The mechanics performing a specific service job were paid 40 per cent of the standard labor charge. The service salesmen were paid a straight salary. In addition to this salary, each service salesman also received a bonus of 5 per cent of the labor charges on all service sales they wrote up over and above $3,000 per month.

Prior to the installation of centralized scheduling in the control tower, all scheduling and delivery-time promises were made by the five service salesmen. These men had the job of meeting the customer, discussing his needs with him, and writing up the customer's order on the invoice form (Exhibit 2). The service salesmen used their judgment of the work load of the shop in making delivery-time promises to the customers. It was then the responsibility of the service salesmen to see that these promises were carried out and that good service and proper attention were given to the customers' automobiles. In order to do this, the service salesmen personally contacted the shop mechanics and arranged with them to have the needed repair work done. Although the service salesmen consistently tried to have the work completed on time, there were many cases in which the delivery promises they had made were not kept. It was chiefly to eliminate these troubles that the service division introduced the control-tower system.

The control tower was constructed in a central location in the shop and elevated above the floor level to facilitate vision and eliminate any interruptions in the work of the tower operator. The control room was enclosed on two sides with glass panels. An electric intercommunication system was installed that enabled the tower operator to carry on a two-way conversation with anyone at the different speakers on the floor of the shop (Exhibit 1); a general public address system was also part of this equipment. A panel of control lights was installed on the outside of the tower; there was a red light, a green light, and a yellow light for each major department in the shop. There was also a message conveyor or shuttle similar to those used in department stores that carried invoice forms from the shop floor into the control tower.

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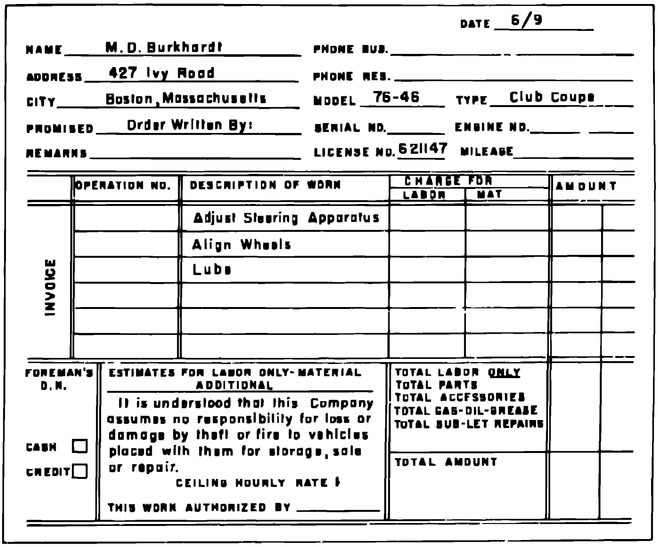
[3] Each of these general utility mechanics normally did only one or two kinds of repair work, but any of them could be shifted to other kinds of repair work in an emergency.



DATE 6/9

NAME M. D. Burkhardt

PHONE BUS.

ADDRESS 427 Ivy Road

PHONE RES.

CITY Boston, Massachusetts

MODEL 76-46 TYPE Club Coupe

PROMISED Order Written By:

SERIAL NO. ENGINE NO.

REMARKS

LICENSE NO. 621147 MILEAGE

	OPERATION NO.	DESCRIPTION OF WORK	CHARGE FOR		AMOUNT	
			LABOR	MAT		
INVOICE		Adjust Steering Apparatus				
		Align Wheels				
		Lube				

FOREMAN'S D. N.

CASH ☐

CREDIT ☐

ESTIMATES FOR LABOR ONLY-MATERIAL ADDITIONAL

It is understood that this Company assumes no responsibility for loss or damage by theft or fire to vehicles placed with them for storage, sale or repair.

CEILING HOURLY RATE $

THIS WORK AUTHORIZED BY

TOTAL LABOR ONLY

TOTAL PARTS

TOTAL ACCESSORIES

TOTAL GAS-OIL-GREASE

TOTAL SUB-LET REPAIRS

TOTAL AMOUNT

Exhibit 2. Corporal Motor Car Company (B). Invoice Form.

Under the new scheduling procedure a service salesman met the customer as usual and discussed his repair and service needs. Before the service salesman made a delivery-time promise to the customer, he referred to the control-tower light panel. A green light under any department indicated that the department concerned was not busy and was ready immediately to start work on any job. A yellow light indicated that the department was temporarily busy and the service salesman could call the control tower to find out when the departmen would be free to work on his customer's car. A red light meant that the department concerned was busy with jobs for the remainder of the day and that the service salesman would have to check with the tower to find out when the department's facilities would become available. With the help of this information the service salesman determined when the shop would be able to start work on the various jobs that needed to be done on his customer's car. The service salesman then drew on his own experience to determine how long his customer's job would take once repair work was started on it. On the basis of these calculations, the service salesman made a delivery promise to his customer. This delivery promise time was entered on the invoice form (Exhibit 2) along with the details of work to be done.

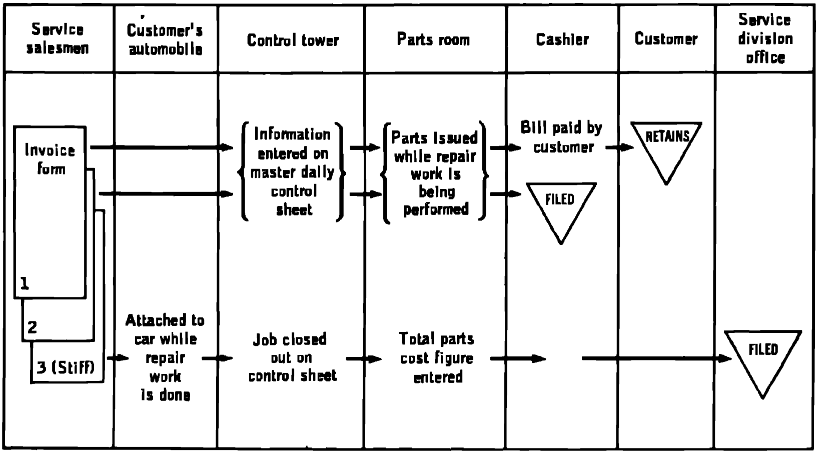

Service salesmen
Customer's automobile
Control tower
Parts room
Cashier
Customer
Service division office
Invoice form
1
2
3 (Stiff)
Information entered on master daily control sheet
Parts issued while repair work is being performed
Bill paid by customer
RETAINS
FILED
Attached to car while repair work is done
Job closed out on control sheet
Total parts cost figure entered
FILED

Exhibit 3. Corporal Motor Car Company (B). Diagram to Show Movement of Invoice Form through the Shop.

The invoice form was made out by the service salesmen in triplicate, and Exhibit 3 is a diagram of the movement of these copies through the shop. As is indicated on the diagram, the first two copies were forwarded by the service salesmen to the control tower. The stiff third copy was attached to the automobile to be repaired in order to supply the necessary information to the mechanics. The control tower entered the information from copies 1 and 2 of the invoice onto the master daily control sheet (Exhibit 4).

The jobs to be done were entered on the control sheet in the order in which they first were received at the tower, and this sequence established the priority order by which each job was given access to the available shop facilities. Once the job order was entered on the master daily control sheet, it was the responsibility of the control-tower operator to meet the promised delivery time. He had complete charge of routing the cars around the shop. If the control-tower operator perceived that it was impossible to meet a promised delivery time, it was his responsibility to see that the customer was informed of the delay and given a new delivery promise time. The whole emphasis of the new system was on moving the cars out of the shop as quickly as possible.

When the invoice had been booked on the master daily control sheet, the control-tower operator dropped the first two copies of the invoice form down a chute into the parts room. These copies were held in the parts room while the work was being performed on the car, and a record was kept on these forms of any parts which were issued to the mechanics for use in connection with the repair job. Each service division employee informed the control tower by telephone as soon as he finished working on any car. When the work on any car was finished, the last mechanic working on the car forwarded the stiff third copy of the invoice to the control tower by means of the message conveyor. The tower operator indicated on his master control sheet that the job was finished and sent the third copy on to the parts room. Upon receipt of this copy, the parts room entered the total cost of all parts issued on each copy of the invoice and sent all three copies to the cashier's desk. When the customer picked up his car and paid for the work at the cashier's desk, he was given the second copy of the invoice for his personal records. The first copy was filed in the central company office, and the third copy was sent to the service division for filing.

The control-tower operator made out a separate master control sheet for major repair jobs that would be in the shop for more than 24 hours. He usually fitted this work into the daily schedule during slack hours of the day.

QUESTIONS

1. At 10:15 A.M. on June 9, Mr. Burkhardt brought his motorcar into the Corporal Motor Car Company for a lubrication job and to get the steering apparatus adjusted and the wheels aligned. Mr. Burkhardt desired the return of his motorcar at the earliest possible time. Mr. Ryan, one of the service salesmen, wrote up the order (Exhibit 2) and checked with the control tower before setting a delivery promise time. The yellow light was burning on the control panel under the steering department; so Mr. Ryan called Mr. Henry,

OWNER	LICENSE NO.	MODEL	INVOICE ORDER NO.	SERVICE SALESMEN'S INITIALS	PROMISE DATE	WASH	SIMONIZE	GAS		HOUR PROMISE *	LUBE	SEAT COVERS	TIRES	AIR CLEANER	FLUSH MOTOR	FLUSH RADIATOR	MOTOR					HEAVY
																	TUNE CHOKE	TAPPETS	CLEAN CARBON	VALVES GRIND	MOTOR SUPPORTS	
STANDARD TIME FOR PERFORMANCE OF WORK IN HOURS						5	EST				6									6		
DOLAN T	145327	41/76	31975	N	6/9				1	5 /	④											
SIDD N	1649	40/70	31052	N	6/9				2	4 /												
MULCHANEY	63491	46/95	31053	N	6/9				3	/	(45)											
KRAWCHER	224978	49/F	31054	N	6/9				4	/	(45)										②	
PLATT CONST	641322	46/76	31635	G	6/9				5	/	④						③					
O'HARE	278144	41/76	31979	R	6/9				6	12 /	(45)						■					
LYNN UMORELLA	633601	41/76	31406	N	6/9				7	/	④						■					
REVITA	844732	41/66	31057	N	6/9				8	/	④						■					⑤
POWERS N	47320	41 CBD	31018	N	6/9				9	/							■					
REGAN	746210	46/76	31037	G	6/9				0	/							■					
																	■					
HORAN	264119	42/76	31019	G	6/9				1	12 /							③					
ALASTROM	236201	38/F	31020	G	6/9				2	5 /							■					
ELDER	97425	41/66	31067	N	6/9				3	4 /	④						■					
BURKHARDT	621147	41/76	30166	R	6/9				4		C						■					
									5								■					
									6								■					
									7								■					
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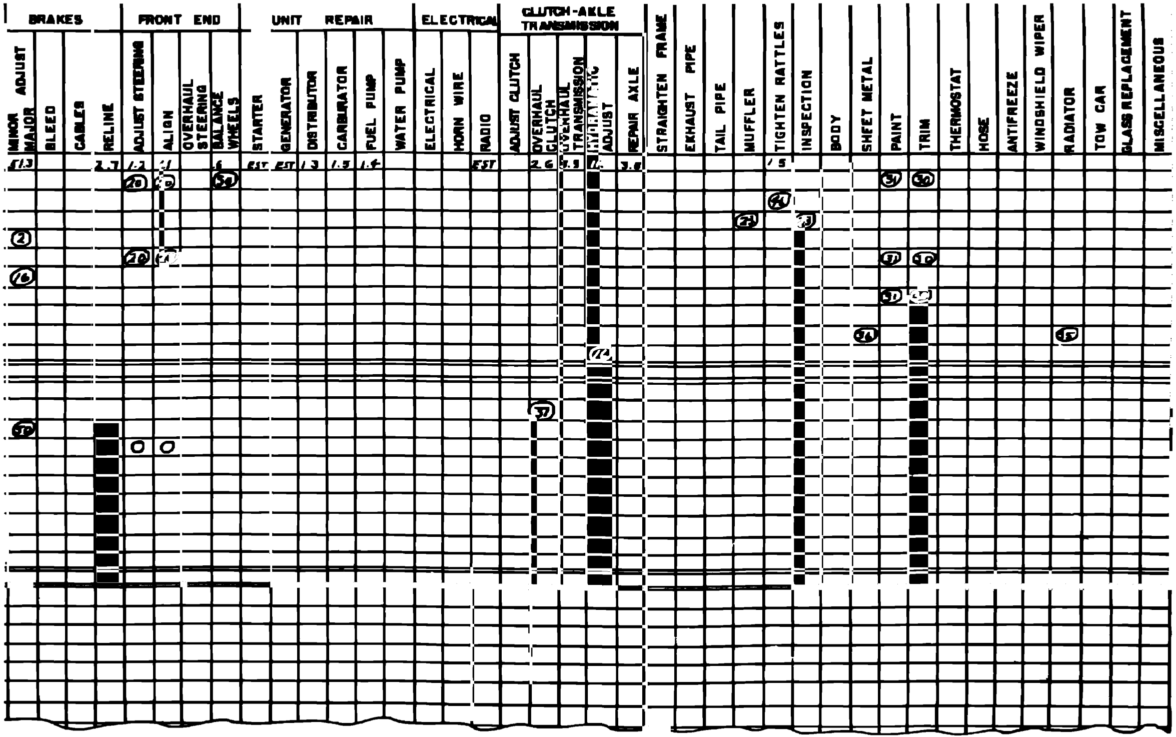


○ Work to be done

② Number of mechanic performing work

/ Work in progress (in hour-promise column)

— Work finished (in hour-promise column)

* A blank in the "hour-promise" column indicates that the car would be picked up after the close of the working day.

Exhibit 4. Corporal Motor Car Company (B). Service Control Sheet for June 9.

the control-tower operator, to find out when Mr. Burkhardt's service work could be started. Exhibit 4 shows the condition of the control sheet when Mr. Henry received Mr. Ryan's call. Operator 20 was the only mechanic who did steering adjustments and wheel-alignment work, and he had started work at 8:00 A.M. on Mr. Dolan's car. Operator 20 normally took a half hour for lunch. What time should Mr. Henry give as the time when the work could be started on the steering apparatus and the wheels of Mr. Burkhardt's car? What delivery promise time should Mr. Ryan give Mr. Burkhardt?

2. Evaluate the production control procedures of the Corporal Motor Car Company.

PROBLEM 50 JACKSON MANUFACTURING COMPANY

The Jackson Manufacturing Company employed a new production executive and assigned to him the task of working out production control procedures that would give the company more complete utilization of existing plant facilities, less waste of labor and materials, and better service to customers. After studying the company's control problems, the new executive set up a procedure for the company's cosmetic container line which proved to be a real improvement. Several months later the new executive proposed applying this procedure to other company lines.

The Jackson Manufacturing Company was the largest manufacturing unit of a large corporation which controlled the conversion of raw copper taken from its mines and smelters through its rolling mills and manufacturing plants. The products of this manufacturing unit were in seven lines called special order, plumbing fixtures, electrical goods, lighting fixtures, cosmetics, cigar and cigarette novelties, and giftware.

Special-order goods were largely brass parts sold direct to other manufacturers in large volume. Brass fixtures used by a refrigerator manufacturer were a typical special-order item. The plumbing fixtures line included faucets, unions, pipe, etc., of highly polished nickel or chromium finish. These were sold through plumbing supply houses. Electrical goods constituted a variety of brass parts common to lighting installations. The lighting fixtures line overlapped the electrical goods to a certain extent, but was differentiated in that lighting fixtures were more expensive and included more complicated assemblies of more parts; the line included table lamps, floor and wall lamps, sconces, and chandeliers. Electrical goods and lighting fixtures were sold through supply houses and direct to large retail organizations and to mail order houses. Cosmetic goods consisted of rouge boxes, compacts, lipstick holders, and other allied products, produced for cosmetic manufacturers and for retailers. Cigar and cigarette novelties were not materially different, except in use, from the giftware line which included such articles as cocktail shakers, cocktail cups, candlesticks, serving dishes, book ends, and miscellaneous giftware. The company manufactured approximately 5,000 items in all. Sales volume in the different lines was divided about as follows:

Special order	15%
Plumbing fixtures	30%
Electrical goods	20%
Lighting fixtures	1%
Cosmetics	10%
Cigar and cigarette novelties	7%
Giftware	17%

The plant of the Jackson Manufacturing Company was fifty years old. Because of its age and the haphazard growth in type and volume of product, it was not highly efficient with regard to arrangement of equipment, layout of departments, and working conditions. The building was of brick and concrete, six stories in height with a basement. Equipment included both the most modern developments and obsolete and antiquated machines. Because of lack of space, the new line of lighting fixtures was housed in a converted warehouse a short distance from the main building.

Approximately 2,000 workers were distributed among 25 production departments which included:

Processing departments

General material stores
Foundry
Rolling mill
Shear
Screw machine
Spinning
Draw bench
Press (stamping and drawing)
Forging
Machine shop
Heat-treating
Central plating
Buffing
Enameling
Packing and shipping

Product departments

Special order
Plumbing fixtures
Electrical goods
Lighting fixtures
Cosmetics
Cigar and cigarette
Giftware

Although the production operations were comparatively simple, manufacture was complicated by the fact that many products were not made in sufficient volume to warrant segregation of production. As a result, several departments did processing that was common to a number of products, whereas other departments concentrated upon a particular line of products. Often the nature of a process made it necessary for all the work of that type to be concentrated in one department as centrally located to other departments as the plan of the building permitted; for this reason all plating was done in the central plating department on the second floor of the plant, and all casting was done in the foundry. When the volume was large or the work highly specialized, a section of a processing department was set off for work upon one product or a line of products.

An article, on the average, was made up of 20 parts and required about 25 processing operations. Sometimes a part or product was completed in one operation. For instance, some special-order goods were manufactured complete from brass rod by automatic screw machines in the screw machine department. More often a product or part was routed from one department to another where operations common to many lines were performed.

Raw materials in the form of wire, rods, and sheets were received from the rolling mills ready for immediate processing except for certain requirements in sheet brass. These requirements were met by a small department set up for rolling brass sheets at the Jackson plant. The foundry could utilize the scrap accumulated in the manufacturing process. For many types of product it was necessary to purchase finished parts of material other than brass and copper.

The plumbing fixtures line, which made up 30 per cent of the total volume, consisted of fixtures such as faucets, mixing valves, shower heads, shutoff valves and unions, and of plated and polished pipe. Fixture parts were cast in the foundry or were machined from bar stock in the screw machine department. Cast parts were machined on special tools in a separate department known as the plumbing fixtures department. Sheet-metal parts were sheared, stamped, or drawn on presses that were used exclusively for plumbing fixtures. These presses were located in the plumbing fixtures department. All fixture assembly work was done in this department. Pipe to be plated was cut to standard lengths in the general materials stores department. Plating and polishing of both pipe and fixtures were done in the central plating and buffing departments. Parts castings were inspected in the plumbing fixtures department before machining. Machined parts were inspected immediately following the machining operations. Plated parts were inspected in the plating and buffing departments. Final inspection of assembled units was done in the plumbing fixtures department. The superintendent of the plumbing fixtures department was responsible for all operations carried on in his department. About 1,800 different parts were required for the plumbing fixtures line.

In comparison to other lines, cosmetic products were less varied and less difficult to produce. The operations were fast. There was an average of five parts and not more than 15 operations to a finished article. Rouge boxes were typical of the cosmetic line. Parts for a rouge box, when produced in small lots, were cut and drawn, marked, stamped, necked, trimmed, and cleaned in the cosmetics department. Where rouge boxes were produced in large volume, however, the stamping was performed in another department, the press department, because the equipment there was more economical on long runs. The machining operations for a rouge box consisted of piercing the hinge hole and nip. Equipment for these machining operations was in the machine shop which served to machine all types and parts of all products. Certain types of rouge boxes were enameled while others were plated. Parts to be enameled were brightend by dipping in a cleansing solution and then sent directly to the enameling department. Parts to be plated passed through the buffing department and then to the central plating department. The cosmetics line had a segregated assembly in the cosmetics department where the top and bottom of rouge boxes and compacts were hinged, the mirror, a purchased part, and bezel added, and the boxes inspected and packed.

All departments in the plant except the automatic screw machine department were on piecework. In five departments the piecework was on a group basis. The automatic screw machine department was on straight daywork with standards of production set up as a control over individual output.

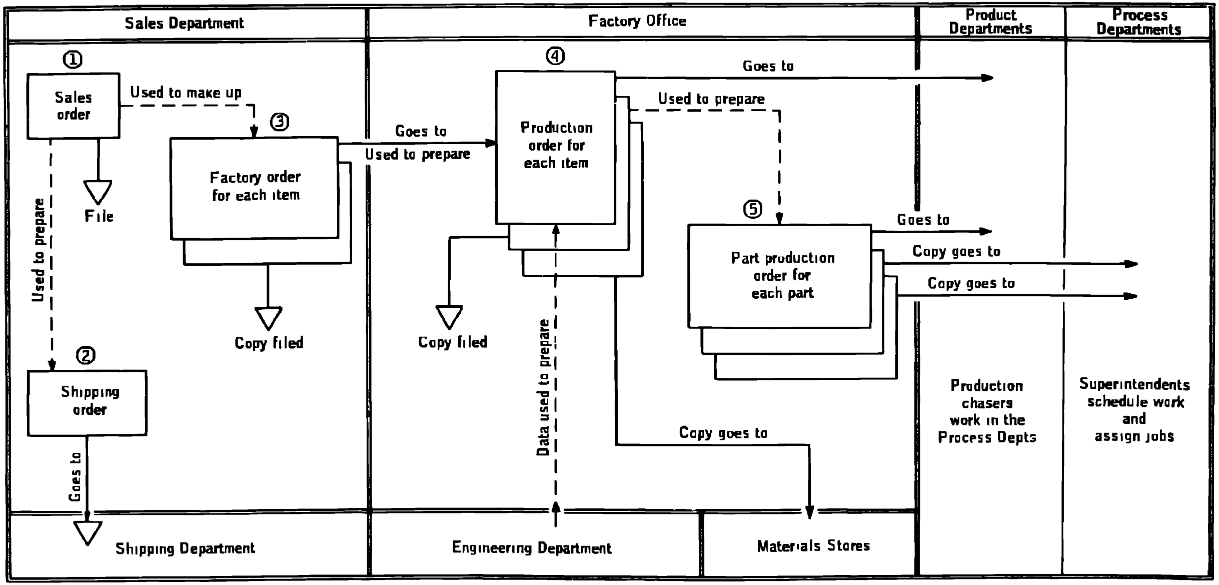
Most of the operations required relatively unskilled labor. A few operations, notably spinning and drawing, necessitated workers of considerable skill and experience. With an increased volume of production, it often was difficult to secure new employees as efficient as the workmen of longer service. The plant was open shop, with only the machinists and buffers having union affiliations.

The existing system of production control placed the responsibility for production largely in the hands of department superintendents. The factory office was concerned only with the transmission of orders to the product departments and the process departments. When a sales order was received by the sales department, a shipping order showing the delivery promise was prepared and sent to the shipping room. At the same time the sales department made out a factory order for each of the items included in the sales order. Each factory order specified the volume of the item required and the shipping date. One copy of each factory order was sent to the factory office and one copy was filed with the sales order.

From the factory order and information available in the engineering department, the factory office made out a production order which specified the parts required and the volume of each, the sequence of operations on each part, the materials required for each part, and the shipping date of the order. One copy of this production order was sent to the materials stock room, one copy was sent to the proper product department, and one copy was retained in the factory office.

From the production order the factory office made up a part production order for each component part of the article. The part production order specified the part and volume required, listed the operations required on the part in the proper sequence, and also showed the shipping date. A copy of each part production order was sent to the proper product department, and a copy was also sent to each of the process departments that would work on the part. The superintendents of the various process departments scheduled and assigned the work within their own departments in accordance with their ideas of balanced production. In the smaller process departments the foremen performed the functions of department superintendent. Exhibit 1, page 527, is a diagram of the procedure just described.

In order to meet the delivery requirements of the sales department, it was necessary for each product department to maintain a permanent force of production chasers who followed certain orders through the plant requesting priority of work upon those items which were delayed or unlikely for one reason or another to be delivered on time. For instance, the production of giftware with a decided seasonal peak for Christmas shopping necessitated considerable readjustment of production schedules in the fall of the year. Another factor in delayed production was the necessity of transferring work because of machine



1. Sales order received from customer.
2. Shipping order, shows shipping date, made up from sales order.
3. Factory order, one for each item on sales order, shows volume required and the shipping date, made up from sales order
4. Production order, one for each factory order, shows parts required, volume of each part, sequence of operations on each part, materials required for each part, and the shipping date of the order.
5. Part production order, one for each part, shows volume required, sequence of operations on the part, and the shipping date.

Exhibit 1. Jackson Manufacturing Company. Diagram of Production Control Procedure.

breakdowns which were frequent and occurred at unexpected times. The number of chasers depended upon the volume of production and the amount of rush orders at a particular time.

The general manager believed that this system of production control was partially responsible for the loss of customer good will through failure to meet delivery promises. He felt also that the company was not obtaining the most profitable operation of its plant because of an excessive amount of rework and rejections. For these reasons, the general manager hired a new executive, with experience in the control of production at an efficient plant in the vicinity, and assigned him the job of improving the manufacturing situation. The title of the new executive was production superintendent.

The success of the new production superintendent depended, in the opinion of the factory manager, upon the extent to which he established adequate control over three sources of production inefficiency: the selection of the most economical processing, the reduction of rework or so-called "reoperations," and the meeting of delivery promises. A major factor in the selection of the most economical processing, in his opinion, was a correct emphasis upon quality that would prevent the expenditure of unduly expensive time and effort upon the low-priced goods. The factory manager was also concerned with the adequacy of the steps taken to prevent bottlenecks of production that had occurred in the plating department, the buffing sections, and in the assembly work, and that had resulted in serious production delays. The equipment for plating included a new conveyor installation which made it possible to turn out four times the work with 25 per cent of the previous work force. The new equipment complicated the dispatching of the work, however, as only articles requiring similar plating could be processed at the same time.

The new production superintendent proposed several changes in the existing methods of control. Responsibility for the planning of production would be centralized. With the aid of load charts showing the amount of work ahead for departments and machines, the work represented by incoming orders would be definitely scheduled as to the particular machine on which the operation would be performed and the time at which the operation would start. A production executive for each line, seven in all, would be assigned the responsibility for the planning, scheduling, and follow-up of orders for his particular group of products. Departmental production would be reported to the seven executives and posted on progress charts against the predetermined schedule at intervals of two hours. These executives were to be located in a central office where the data on processing, machine capacity, and order analyses would be concentrated.

For each factory order for a particular article, a progress chart would be prepared to which would be posted the production of the individual parts necessary to meet the shipping order. This chart would indicate at all times the stage of completion in the manufacture of the order, the parts that were behind schedule, and the amount of time required to perform the remaining operations. It was believed that one girl for each line of product could handle the required posting of records.

Department production would be reported directly to the central office rather than to the department superintendent. In addition to the progress chart, it was proposed to record daily department production. A record of total daily production by article numbers would be entered on a card on which also would be entered the quantities ordered into production. Work reported as "reoperations" and as rejections also would be recorded. These records would provide a check on the efficiency of department operations.

Because production efficiency was particularly unsatisfactory in the cosmetics line, that line was used for experiment with the new method of control. At the end of four months' experience with the new procedure, the control of production in the cosmetics line had been distinctly improved and the management was considering the further extension of the system to other products.

QUESTIONS

1. To what do you attribute the "success" of the new production control procedure applied to the cosmetics department?

2. What reasons are there to believe that extension of the control system to other products would or would not produce results comparable to those attained on the cosmetics line?

3. Do you approve the proposal to extend the new system to all the company's production?

PROBLEM 51 GEORGIA-JACKMAN COMPANY

The Georgia-Jackman Company manufactured steam turbines of standard design which were sold to public utility companies, shipbuilders, and manufacturing plants. The favorable reputation which had been established was based primarily on the quality of the product

> and on the service rendered by the company in speed of delivery, in installation, and in the maintenance of turbines thereafter. Because the company wished to sustain this reputation, and because 80 per cent of the 1,600 parts of a Georgia-Jackman turbine were peculiar to the product of the Georgia-Jackman Company, almost all the parts were made in the plant. The exceptions were castings, which were made at a neighboring foundry, and standard hardware, such as nuts and bolts, which was purchased more cheaply than it could be made in the factory.

Company operations were divided among six departments: engineering, sales, bookkeeping, cost accounting, production, and superintendence. The engineering department controlled the drafting room, erection of turbines away from the plant, repairs, and final testing. The cost accounting department compiled costs and the payroll. The superintendent had charge of the inspectors and exercised direct supervision over the foreman, and through them over the men. The production control department controlled purchasing and stores, issued work orders to the manufacturing sections, and determined the type of machine to be used. In cases where there was a conflict in authority between them, the superintendent and the production control manager were expected to work out an agreement or, if no agreement were possible, obtain a decision from the production manager. The six heads of departments had frequent informal meetings to discuss their problems, and occasionally more formal conferences were held with the production manager.

Work in the production department was performed in the "shop" which manufactured parts and in "assembly" which combined manufactured parts into finished turbines. The shop made parts of three classes: for stock, for scheduled assembly, and for turbines in the process of erection for which a piece was needed immediately. In the shop there were manufacturing sections, each headed by a foreman, devoted exclusively to the manufacture of valves, shafts, wheels, gears, bearings, and glands, in each of which was all the equipment necessary to manufacture a complete part. Thus, since different parts required similar processes, there were duplicate machines scattered throughout the building. Within each manufacturing section the machines were segregated by type, all boring mills together, all lathes together, etc.

Normally the Georgia-Jackman Company had 500 employees. Many of its foremen, who had been in the organization for 20 to 25 years, understood thoroughly the company's production problems and were accustomed to accepting responsibility. With such a staff, the officers had not considered it essential to install detailed centralized production control. Within each section the work had been directed by the foreman, who had arranged the order of work according to priority demands from the production manager's staff. The production manager recognized that the control procedures in the company were less systematic than was commonly considered "best practice," and, following the advice of a consultant, he set up within his department what was in effect a centralized production control group.

The company seldom produced at a rate in excess of two-thirds of capacity. It was customary to estimate sales orders for three months in advance on the basis of experience, business conditions, and any other data available. The estimates made it possible to coordinate the production of parts for stock with the available machine hours and with the probable demand. Supplies of the parts which were used most frequently were kept continuously in stock. The stores clerk made requisitions on the production department in sufficient time to prevent depletion of the inventory. Other parts which were required in small lots at infrequent intervals were not maintained continually in stock. When a quantity of such parts was needed, it was customary to manufacture more than the number temporarily required, in order to make possible economical runs. Whenever it was economical, however, such parts were manufactured only as needed, in order to avoid excessive inventories.

After an order was taken by a salesman, it was sent to the sales department where the price, horsepower, and general make-up of the turbine were checked. The treasurer approved the order and sent it to the production department which scheduled it for shipment and made out an assembly sheet showing detailed specifications and final delivery date. From the latter the engineering department selected the proper blueprints from the files and drew up a bill of material. A work order for each piece to be manufactured was then made out in quadruplicate by the production department. The first copy was held by the cost accounting department until the completion of the part; the second, which was sent to the stock room, served as advance notice of what parts were to be drawn; and the third and fourth copies were given to the section foreman, one to serve as an instruction sheet and the other as a requisition on stores for the material needed. When parts had been completed and inspected by the foreman and by the regular inspectors, they were sent to stock. Sufficiently in advance of erection to ensure the presence of all the parts, the pieces for each turbine were collected in a section of the plant called the "bank." When all the parts needed for a turbine were in the bank, the production department issued an erection order, which gave the erection foreman authority to draw the assembled material from the bank. After erection, the turbine was tested by the engineering department and shipped to the customer.

For each part to be manufactured, an employee on the production manager's staff made out a book of job tickets which specified, in order, the operations to be performed, the type of machine to which each was scheduled, and the latest date on which the part must be completed. This detail was necessary because some operations could be performed more cheaply on one type of machine than on another. Where breakdowns or excesses of work made it necessary, the consent of the production manager's staff was secured to alter the procedure. Each foreman kept a file of the job tickets issued to him with the date of required completion plainly visible on each ticket. He kept a second file of job tickets for rush orders to which were attached red stickers to emphasize their importance. These rush orders, which were arranged in order of precedence, were rearranged daily by a man from the production manager's staff. Such rearrangements were necessary because of changing delivery dates which resulted from rush demands from customers or delay in completing parts or in securing parts from other manufacturers.

Each foreman was responsible for the performance of his section. He could assign jobs to particular machines as he deemed advisable. A machine operator soon became familiar with all the processes which were performed in his section. Consequently, it was ordinarily a matter of little importance which operator received a job. Although the foremen were able to operate all the machines in their sections, they devoted their entire time to supervising the men, to inspecting the work, and to managing the sections.

The workers in the parts production sections were paid piece rates which had been set by the foreman and the plant superintendent. These rates were not based on time-study standards.

A list of turbines under construction with promised delivery dates was kept on a large board in the production manager's office. Colored pins traced each turbine from order date to shipping date and revealed plainly the progress of construction. If a turbine was delayed, the reason was indicated on the board. From this board the production manager was able to determine when to erect any unit and when to promise delivery. The production manager was so thoroughly conversant with the operations of the plant that he knew whether or not the work was going smoothly. The existing method of control was familiar to the foreman and the men. If the machines in one section were overloaded, the idle equipment elsewhere in the building was utilized at the direction of the production manager. Production usually was so far below the capacity of 200 turbines per month that other machines were available when needed.

The production manager believed that the Georgia-Jackman Company had not suffered the great lowering of worker productivity that was characteristic of many companies during the Second World War. He attributed this to two things: the preponderance of older workers on the company's payroll and the refusal of the management to expand the company's activity as so many companies had done during the war. He believed that the result was a favorable competitive advantage for his company.

Nevertheless the production manager set up a small standards group within the production department and started to make time studies of all parts production. These studies were not extended to the turbine erection section. During a period of four years the time-study standards were used to revise completely all piece rates in the parts production sections. The installation of the new rates was so timed in relation to the several general wage increases of the period that no piece rate was ever reduced and no workers ever suffered a reduction in weekly pay. There had been many out-of-line rates prior to the setting of time-study standards. The new rates had eliminated these inconsistencies, and the wage increases during the period had been fortunate in that they had made it possible to reconstitute the wage structure without working hardship on any employee. The workers had been fully aware of what the management was doing and raised no objections. They had never been promised that their earnings would not be reduced as a result of the piece-rate changes and had shown no interest in participating in the setting of new standards. The fact that the installation of new rates had been so timed that all rate changes represented increases seemed to satisfy them completely. The treasurer, the production manager, and the superintendent were in complete agreement that the standards setting program had resulted in increased worker pay, increased output per man hour, and lower manufacturing costs.

The only people who had seemed dissatisfied with the postwar changes were the foremen. Following the setting of new piece rates, a change had been made in the job tickets issued to the parts production sections. The old ticket carried the date by which the part order must be completed. The new ticket showed the date on which the work was to be started as well as the date on which the work was to be completed. The new time standards on jobs had made this change possible and thereby gave the production department much closer control over the work of the parts manufacturing sections.

At first the foremen had all ignored the starting dates on the job tickets and had scheduled the work within their sections as they had in the past—with reference to the completion dates only. As a result the proportion of rush orders increased. The production manager believed that this was because the schedule clerk in his office found that less time was needed between the issue of job tickets and the completion dates thereon. Prior to the determination of the new job standards, this time allowance had been based on performance experience; the new job standards permitted a much more accurate predetermination of how much time should be required.

The foremen grumbled about the increase in rush work. The production manager's response was to explain to the foremen, in a meeting called for the purpose, why the number of rush orders was increasing and why rush orders would be almost completely eliminated if the foremen would schedule the work exactly as instructed by the production department. He went over with them the many advantages to be gained from shortening the manufacturing cycle time and eliminating rush work.

Subsequent to this meeting the foremen paid more attention to the starting dates on the job tickets, and slowly the proportion of rush orders decreased. The production manager believed that eventually complete acceptance of the new plan by all the foremen would practically eliminate the rush order situation.

In January, 1961, one of the older foremen asked the production manager if he would call a meeting of all the foremen to have a conference on the plant problems. At the start of this conference the same foreman practically "took over" the meeting by saying that he was speaking for all the foremen and that they were unanimously insistent that the production control system be changed back to what it was prior to the setting of the time-study standards. He pointed out that the company was now operating at capacity. He referred to the fact that the foremen had been informed that the company now had a backlog of orders that would keep it busy for two years and that the sales engineers had been "pulled off the road" and had been transferred to the engineering department where they were devoting all their time to the installation of finished turbines because the company did not intend to take any additional orders during the next 12 months.

Under the circumstances the leader said that all the foremen believed that the present method of production scheduling was both unnecessary and foolish. At this point all the foremen seemed to start talking at once. As soon as he could make himself heard, the production manager assured the foremen that the company executives would immediately undertake a consideration of their request and adjourned the meeting.

QUESTIONS

1. How do you explain the reaction of the foremen to the centralized production control system?
2. What should the management do?

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RAW MATERIALS INVENTORY CONTROL

EMPIRE COMPANY

1. A COMPANY REORGANIZES ITS INVENTORY CONTROL ROUTINE

The Empire Company manufactured surgical supplies. Materials used were segregated into three groups under the captions unclassified stores, classified stores, and cotton materials.

A continuous, or perpetual, inventory of classified stores was maintained. In the past the book inventory record of each item had been checked by physical count whenever the tag record at the bin was full and a new tag was required. Consideration was given the frequency with which physical checks were made.

2. IMPORTANCE OF RAW MATERIALS INVENTORY CONTROL

Most manufacturing operations require raw materials or purchased parts for processing. The problem of supplying such necessities has been treated in Chap. 9. Acquiring title to or physical possession of raw materials and purchased parts is only the first step in ensuring their presence when needed in processing. The control of parts and raw materials after they have arrived at the plant receiving dock is essentially a matter of factory housekeeping. It is an important problem, however, and its solution is essential if process flow is to be uninterrupted, preplanned results are to be accomplished, waste is to be kept at a minimum, and costs of production are to be controlled.

3. PURCHASING POLICY OF THE EMPIRE COMPANY

The Empire Company manufactured gauze and absorbent cotton products for surgical use. The products were marketed through wholesale medical supply houses and directly to hospitals and to the medical services of the government. The company employed 250 people. Supplies and raw materials inventories were divided into three types: unclassified stores, classified stores, and cotton materials. The unclassified stores, such as lumber for minor repairs and articles of office equipment, were not carried in stock regularly, but were purchased from time to time as the need arose. Classified stores were those articles regularly carried in stock to be used for recurring manufacturing and administrative purposes. Cotton materials included raw cotton and gray cloth. These two items were purchased by a purchasing specialist who based his activities on estimates of consumption, future orders, and market conditions. Classified and unclassified stores were purchased routinely by the purchasing agent.

Replenishment of classified stores was controlled by the stores ledger clerk in the planning department. The stores ledger record consisted of a file of cards, one card for each item of stores. These cards provided the information which formed the basis of classified stores control. The card showed the clerk what needed to be purchased, how much should be purchased, and when requisitions should be made. The actual purchasing was done by the routine purchasing agent upon requisition from the stores ledger clerk in the planning department.

4. THE CLASSIFIED STORES LEDGER

The form in Exhibit 1 illustrates the stores ledger card used by the Empire Company. The information on this card was of three types: general information, record of consumption, and inventory details. At the top of the sheet were spaces for general information of importance for control purposes: the name of the item, its classification symbol, its location in the storeroom, description of the item, order point, and amount to order.

5. DETERMINING THE ORDER POINT

The order point was the figure below which the amount on hand, as indicated on the card, should not go without a requisition for additional purchase being sent to the purchasing department. This point was fixed by the head of the planning department. In setting it, he considered such matters as average monthly consumption, time required to purchase and obtain delivery, and the most economical size of purchase order. Once the order point had been fixed, it was entered in the proper space on the card. The order point was reset whenever changes in any of the controlling factors made alteration advisable. Each day the stores ledger clerk went over the cards in the file to make entries on them. Whenever a card showed that the amount of an item on hand was down to the predetermined order point, he made out a

Exhibit 1 Empire Company

Balance-of-Stores Sheet

Name__________ Symbol__________ Location__________

Description____________________

Order Point__________ Amount to Order__________

Average Monthly Consumption

Months																						
Consumption																						
12-month Average																						

Receipts	Issued	On Order			Balance on Hand
		No.	Date	Am't	

requisition for the amount shown on the card as "Amount to Order" and forwarded it to the purchasing department.

Fixing of the order point and amount to order was facilitated by the record of monthly consumption shown in the second section of the card. There each month's consumption in physical units was recorded, and beneath it was entered the average of the past 12 months' consumption. Increase or decrease in the trend of this average was useful in making revisions of the amount to order and the order point.

6. BALANCE-OF-STORES SHEET—A PERPETUAL INVENTORY

The clerk obtained the monthly consumption from the third section of the balance-of-stores card. There were four major headings: Receipts, Issued, On Order, and Balance on Hand. In the Receipts column were entered the physical amounts of all in-shipments of the item when they were received in the storeroom. The Issued column contained a record of all amounts of the item issued to the processing departments. Items were issued upon requisitions signed by department heads or their designated representatives. The Balance on Hand column at all times showed the existing excess of receipts over disbursements of the item. It was always possible to know the amount of an item on hand by referring to the proper ledger card and noting the last entry in the Balance on Hand column. Whenever stores were received or issued, the amounts were recorded in the Receipts or Issued columns and the proper addition or deduction was made in the Balance on Hand column. The stores ledger thus always contained complete, up-to-date information relative to the classified stores inventory. The value of the classified stores inventory could be quickly obtained by taking the physical balance on hand from the balance column of each card, pricing it, and totaling the valuations thus obtained. The stores ledger itself did not contain any monetary figures.

The On Order columns of the balance-of-stores sheet provided valuable information. Whenever the stores ledger clerk found that the balance in the Balance on Hand column was down to, or below, the order point and therefore issued a requisition to the purchasing department, he entered the number of the requisition, the date, and the amount of the requisition in the proper On Order columns. This made it possible for him to determine at any time, not only the volume of an item on hand, but also the amount that could be expected to be on hand in the near future, and the approximate date when an in-shipment would arrive. When a shipment came into the storeroom, the stores ledger clerk made the proper entry in the Receipts and Balance on Hand columns and then, in the same space in which he had noted the date of requisitioning that in-shipment, he wrote the date on which the shipment had been received. The head of the planning department had found this information of value in revising order points and amounts to order.

7. CLASSIFIED STORES CONTROL ROUTINE

Purchase requisitions for classified stores originated in the planning department as a routine matter. These requisitions were authorized by the head of the planning department, and then they were sent to the purchasing department. Each such requisition had to be approved by the works manager, after which a purchase order was made out in quadruplicate. The original was sent to the vendor. The second copy was sent to the planning department as a notification that the requisition had been approved and the order placed. The third copy went to the receiving clerk in the storeroom. He used it as a basis of checking the order and its invoice when the stores arrived. The fourth copy was retained in the purchasing department, where it was used to follow up the order and see that delivery was made on schedule. When classified stores were received in the storeroom, a careful inspection was made for quantity and quality. Accepted stores were then placed in stock, each item of stores having its own bin in a definite location in the storeroom. On each bin was a tag. The tag gave the description, symbol, and location of the stores item contained in the bin. There were also three columns similar to the Receipts, Issued, and Balance on Hand columns of the balance-of-stores sheets in the stores ledger. Whenever additional items were placed in the bin, the amount was entered in the Receipts column on the bin tag and the amount in the Balance on Hand column on the tag was increased proportionately.

At the time he placed in-shipments in stock, the receiving clerk in the storeroom made out a notification of stores received and sent it, together with his copy of the purchase order, to the classified stores ledger clerk in the planning department. The ledger clerk made the proper entries on the balance-of-stores sheets and forwarded the papers received from the receiving clerk to the accounting department.

In the storeroom, classified stores were issued only on the authority of factory department heads or their representatives, such authorization being made in the form of a signed stores issue slip. When stores were issued, the receiver signed for their receipt on the slip. After the issue of stores had been recorded on the proper bin tags, the stores issue slip carrying the storeskeeper's signature was sent to the stores ledger clerk in the planning department. There it formed the basis of making withdrawal entries on the proper balance-of-stores sheets, after which it was forwarded to the accounting department.

Whenever stores that had been issued were returned to the storeroom, entries were made on the bin tag and a stores credit slip was made out and forwarded through the regular channels.

8. FUNCTION OF THE BIN TAGS

The routine here described was built around two records: the bin tag and the balance-of-stores sheet. The bin tags provided the storeskeeper with the information he required to carry out his function. The storeskeeper signed for all stores received and was held personally responsible for them until they were checked out of the storeroom on authorized stores issue slips. The storeskeeper's responsibility covered a great number of items of large aggregate value. Dozens of storeroom transactions were effected every day. It was essential, therefore, that he have an orderly record of all that went on. The bin tags constituted that record.

9. FUNCTION OF THE BALANCE-OF-STORES SHEETS

A detailed knowledge of the condition of the classified stores inventory was essential to the planning department if it was to discharge its function. The balance-of-stores sheets which made up the classified stores ledger provided this detailed information at all times. The routine whereby these records, the balance-of-stores sheets and the bin tags, were maintained was essential to the orderly and effective control of classified materials.

10. CHECKING THE BOOK INVENTORY

If no errors were made in the carrying out of the routine just described, the balance on the bin tag for store SES2D would exactly agree with the balance as shown on the balance-of-stores sheet for SES2D, and likewise this figure would accurately represent the number of pieces actually in the bin. The reliability of a continuous inventory record depends on the extent to which the inventory shown on the balance-of-stores sheets represents exactly what is on hand in the stock room.

It is practically impossible to eliminate all inventory discrepancies. To keep errors at a minimum it is necessary to make periodic checks.

The number of pieces in a bin are counted and results compared with the balance shown on the bin tag. In the past this had been done in the storeroom of the Empire Company whenever an entry, made as the result of an addition to or withdrawal from the bin, filled the last space on the bin tag. If there was any discrepancy, it was noted on the bin tag and either a stores received or stores issue slip was made out for the amount long or short. The reason for the issuance of an "adjustment" slip was noted on the slip, which was signed by the storeskeeper and forwarded with the completed bin tag to the planning department. The head of the planning department then authorized a similar adjustment to be made in the classified stores ledger.

In the storeroom a new bin tag was made out with the corrected balance brought forward from the old bin tag. In this way the perpetual book inventory was checked by physical count.

11. PROPOSED CHANGES—ADVANTAGES AND DISADVANTAGES

It had been proposed by the head of the planning department that the old bin tag be forwarded to the balance clerk, a physical count taken, and a new bin tag made out each time a new lot of a store was received. This, he pointed out, would reduce the chance of error between the quantity of the supply recorded on the balance-of-stores sheet and the actual quantity in the bin. The size of readjustments in the records would be minimized, because physical inventory, if taken each time a shipment of supplies was received, would be more frequent, and any necessary adjustment would be made immediately. The number of adjustment entries might increase somewhat, but the greater accuracy growing out of more frequent check would be of sufficient advantage to justify the increased work, particularly since the planning department head believed no additional clerks would be required to carry out the plan.

On the other hand, the planning and manufacturing departments had been troubled only slightly by the occasional discrepancies which had occurred between the actual inventories in stock and the records of them on the balance-of-stores sheets. Both the chief storeskeeper and the planning department head thought that such errors as had occurred were caused by occasional rush conditions which made for carelessness. Only rarely, when serious or repeated discrepancies were found, had attempts been made to place responsibility.

Approximately 2,400 bin tags per year were used for 1,200 items, and it was estimated that about 5,000 additional tags per year would be required under the proposed plan. Supplies were received every two months on an average, whereas receipts and issues for a period varying from six months to two years in length could be entered on one tag. The practice of checking a bin when the tag was full had resulted in checking those items in active use more frequently than those with slower turnover. This was recognized as desirable. A change to checking each time stores were received would have the effect of making the checkup of all items more frequent.

As a result of study of the proposal of the planning department head, the chief storeskeeper suggested that a change be made along somewhat different lines. He asked that each morning the planning department send to the stores department a list of 20 or 25 items to be inventoried and bin tags checked during that day. He believed that this would afford a better check of the book inventory. In making up the daily check lists, the planning department clerk could see to it that all items were checked at regular intervals, that items most subject to error were checked most frequently, and that the total inventory was checked at least once in each 60- to 90-day period.

This method would regularize the volume of physical inventory work required in the storeroom. Checking inventory when bin tags were full occasionally caused inconvenience if a large number of tags happened to be completed in one day. Furthermore, checking from a list would be more convenient, since the work could be done when storeroom clerks were not otherwise occupied. This method would also have a greater tendency to discourage any pilfering. Although the chief storeskeeper did not believe this to be a problem with the Empire Company, he recognized it as a matter of common consideration in stores control.

12. WHAT THE COMPANY DID

The planning department head studied the chief storeskeeper's plan and came to the conclusion that it was fully as satisfactory as his own as far as providing accuracy in the classified stores record was concerned and that it had certain additional advantages. The work required to make up check lists could be handled by the present staff in his department, and he recognized the desirability of regularizing the volume of adjustment work in his department as well as inventory taking in the stores department. The two departmental heads drew up a recommendation in report form and submitted it to the plant manager.

The plant manager studied the report in detail and notified the department heads concerned to put the recommendations into effect. The plant manager recognized the desirability of accuracy in the book inventory. The Empire Company had installed the perpetual inventory method some years before and had experienced considerable difficulty in bringing its accuracy up to a point where it could be depended on. At the end of the first year of its use, an over-all physical inventory of stores had shown that the book inventory had many glaring errors. However, upon the advice of outside auditors the company had retained the perpetual inventory system and had found that experience in its use had improved it constantly. At the time of the case here discussed, improvement in the book inventory had been such that no over-all end-of-the-year physical inventory had been taken for two years. Outside auditors periodically employed by the company and income tax officials were willing to accept as accurate the inventory figure obtained from the classified stores ledger.

The plant manager recognized the importance of meticulous, systematic control of stores. Processes could not flow smoothly or preplanned results be obtained unless stores of the proper quality and in required amounts were on hand in the various manufacturing departments at the time they were required for processing. Inasmuch as the proposal to regularize physical checking of the classified inventory records used in the planning department tended to improve production control by reducing the amount of discrepancies between book balances and physical count, the plant manager looked with favor upon the plan. The increased accuracy of cost records, operating statements, and balance sheets he considered additional advantages. Finally, the possibility of accomplishing the change without substantial increase in costs of control had caused him to order the new plan into operation.

Experience with the new procedure for checking the perpetual book inventory against the physical inventory proved entirely satisfactory to the planning and stores departments. There were fewer discrepancies between the records and physical counts, and a check after the new procedure had been in effect a year indicated that discrepancies were detected sooner. Work loads in the two departments were more stable. However, a report from the accounting office indicated that the total dollars amount of adjustments made for the year had been reduced only slightly. A study, designed to locate the cause, resulted in a change in the procedure.

The planning department divided the classified items purchased into three groups. Group *A* included all purchased items which had a high-unit value, whether the item was purchased frequently or not. Group *B* consisted of items of low-unit value used in such large quantities as to make the total cost of the item high. Group *C* was made up of low-unit cost items not used in large amounts. In making up the daily lists of items to be checked physically by the stores department, all group *A* items were included in these lists at least once every month. Group *B* items were ordered checked at least once in every three months' period. All group *C* items were included in the check lists only once in each six months' period.

As a result of this change, the items in group *A* were checked much more frequently than previously. This also was true of many of the items in group *B*. Items in group *C* were checked less often. The total amount of checking remained unchanged.

13. SUMMARY AND CONCLUSIONS

Objectives of Inventory Control. In controlling materials inventory levels, too often conflicting objectives must be met. From the standpoint of continuity of manufacturing operations, abundant inventories of all materials utilized in the manufacturing process are desirable. Inventory shortages that disrupt the manufacturing process increase the costs of manufacture. Thus if materials inventory levels were controlled by the plant operating people, they would usually tend to be high. However, inventories represent an investment of funds and involve costs of ownership and storage. Thus, if the determination of materials inventory levels was entirely under the control of a company's treasurer, the tendency would be to keep inventories as low as possible, often lower than the manufacturing people would consider desirable.

A third objective of inventory control is accuracy of the inventory figure for purposes of cost and profit determination. Accuracy is important to management, to stockholders, and to both Federal and local tax authorities. Problems of inventory valuation are beyond the scope of our present discussion, but the need for accuracy for operating purposes is important in designing a procedure for inventory control or in judging the adequacy of or modifying an existing control procedure.

Gains from Shifting Responsibility for Physical Checks. Placing the responsibility for controlling the taking of physical inventories in the hands of the planning people was an improvement in procedure. Frequency of additions to or withdrawals from stock was only one important consideration in determining the amount and timing of physical checks. If a physical check was made each time the perpetual book record was altered, the work load would have been increased greatly. Such frequency of checking would have been excessive.

The A-B-C Inventory Control. The final change in procedure, the

A-B-C segregation, remedied a weakness in the random selection of items to be included in the planning department's daily lists. It was an improvement from the financial point of view. The essence of this modification was to increase the attention given to items that involved larger financial commitments. When the value involved was low and usage was infrequent, minimum checking was entirely acceptable.

Trends in Inventory Management. There is developing some tendency to make all inventory control—raw materials, work in process, and finished goods—the responsibility of a single "inventory manager." If the nature of the manufacturing operation permits, this concept can be expanded to include the functions of operations planning and scheduling. Theoretically there is something to be said for this departure from the usual separation of these activities. Changes in work-in-process level often should be reflected in changes in materials and in finished goods inventory levels. If all three types of inventories are the responsibility of a single executive, any potential gains from these interrelationship changes are more likely to be realized promptly. To obtain optimum gains from this, it usually is necessary to include operating planning and scheduling as part of the inventory control function. There are a few examples of successful operation on this basis. There have been some failures. Much more experience is required before it is possible to generalize with respect to conditions that must exist for this type of control centralization to be suitable and likely to succeed.

The perpetual book inventory with carefully planned physical checks is the most common procedure for assuring adequate, yet economical, control of materials and supply inventories. Properly designed, this procedure will meet the three requirements previously indicated: accuracy, adequate supply, minimum investment. When the volume of work involved is great, mechanization of procedures is becoming an aid to keeping the costs of the procedure within reasonable bounds.

QUESTIONS

1. Explain the procedure for determining when, for what, and for how much purchase requisitions for classified stores should be issued.

2. When a purchase order was written in the purchasing department, four copies were made. The original was sent to the vendor; one copy was sent to the requisitioner; one copy was sent to the receiving clerk in the stores department; and the fourth copy was re-

tained in the purchasing department. What use was made of each of these copies?

3. Upon receipt of a shipment of stores in the storeroom, the receiving clerk, having checked the shipment for quality and quantity, filled out a notification of materials received and sent it together with his copy of the purchase order to the balance-of-stores clerk in the planning department. Why was this done?

4. The chief storeroom clerk was responsible for all materials and stores received by the receiving clerk until such time as they were issued to operating department heads upon proper requisition and written receipt obtained therefor. The bin tag was the device used in the storeroom to facilitate the discharge of this responsibility. Explain its use and value.

5. In the planning department, the balance-of-stores ledger duplicated the information found on the bin tags. Was this duplication necessary or desirable? Explain.

6. What would be the advantages and disadvantages of taking an inventory and forwarding the bin tag every time a new shipment of a store was placed in the bin?

7. What are the advantages and disadvantages of the plan proposed by the head storeskeeper?

8. Do you think the action taken by the works manager of the Empire Company was sound?

9. The balance-of-stores clerk forwarded all stores issue slips and materials received slips to the accounting department after they had been recorded in the planning department. Why was this done?

10. What are the advantages of systematic control of raw materials such as used by the Empire Company? What dangers must be safeguarded against in such a scheme?

11. The purchasing policies of the Empire Company differed for cotton supplies, unclassified stores, and classified stores. Why?

12. What was the responsibility of the purchasing department for raw materials and classified stores purchases?

13. Authorizations for classified raw materials purchases originated in the planning department. Explain the reason for this procedure.

14. The planning department of the Empire Company issued work orders to the various production departments as authorizations of work to be done. The production department heads thereupon made out requisitions for the necessary raw materials. When these requisitions were presented to the storeskeeper, the raw materials were issued, and the department head signed a receipt for them. Would it not

have been better for the planning department to issue the materials requisitions?

15. Why was the *A-B-C* approach to inventory checking considered to be an improvement? How did it accomplish this improvement?

16. In Chap. 2 four distinct aspects of management were described. How does materials inventory control fit into this work classification?

PROBLEM 52 BLACKWOODE AUTOMATIC COMPANY

The Blackwoode Automatic Company manufactured machine tools. A considerable number of parts used in the product were not made in the company's own works. Inventory of parts purchased was controlled by a perpetual inventory ledger.

Machine tools manufactured by the Blackwoode Automatic Company were assembled from three types of parts: standard parts made by the company, standard parts purchased from parts makers, and special parts made by the company to comply with special requirements of the individual customer. Standard parts were made in lots of economical size and placed in stock. Purchased parts were bought at intervals sufficient to meet the assembly needs of the company and carried in stock. Special parts were made up to the customer's specifications after an order had been accepted. No assembly operations were carried on until orders were received. Each order was assembled separately.

When an order was accepted, the planning department prepared a parts list and notified the storeroom of standard parts quantities required for that order and the dates upon which they would be needed. One division of the storeroom was called the "bank." As soon as a parts list covering an order was received in the storeroom, the parts called for were removed from the stock bins to the bank. There parts for one order were placed together in a rack and held for requisition by the assembly division.

As soon as the production of special parts required for an order was well under way, the planning department issued an assembly order to the "erection" division. This assembly order was accompanied by a copy of the bill of materials orginally sent to the storeroom. The copy

Exhibit 1 **Blackwoode Automatic Company**

Purchased Parts Ledger

Name______________________ Number______________________

Pattern Number______________________ Used on Types______________________

Specification Number______________________ Location______________________

Maximum______________ Minimum______________ Order Quantity______________

Ordered				Received			Applied			Issued			In Stores	
Purchase Order No.	Date	No. Pieces	No. Due	Purchase Order No.	Date	No. Pieces	Works Order No.	Date Required	No. Pieces	Works Order No.	Date	No. Pieces	No. Pieces Unapplied	No. Pieces Actual

served as a requisition from the erection department on the storeroom and was the authority upon which parts segregated in the bank for that order were removed to the erection floor.

Both standard manufactured parts and purchased parts were controlled by means of perpetual inventory ledgers. Exhibit 1 shows the form of the Purchased Parts Ledger sheet.

QUESTIONS

1. Explain 'the nature, purpose, and value of each item of information shown in Exhibit 1.
2. Was this record suitable and adequate to the needs of the Blackwoode Automatic Company?

PROBLEM 53 BELMONT JEWELRY COMPANY (B)

The Belmont Jewelry Company manufactured class and fraternity jewelry. Much of its product was made to special designs or specifications submitted by purchasers. A new department superintendent had improved process control in the pin and coat-of-arms department. He suggested that a systematic control of raw materials be devised and installed.[1]

A check of the raw materials used by the Belmont Jewelry Company revealed that about 300 items (sizes and colors included) were carried in stock. None of these items was bulky, and a considerable number of them had a high unit value. Flat gold, gold wire, and small precious stones for jeweling pins and rings were examples.

Orders from salesmen were received in the general office. From these orders an assistant to the plant manager made up production orders, which were issued to the superintendents of the six production departments. These men planned the work within their own departments and requisitioned the materials needed.

Materials were in charge of a storeskeeper in the plant manager's office. Most of the purchasing was done by the president of the company. Theoretically he bought on a routine basis from information as to stocks on hand furnished him by the storeskeeper. Occasionally, however, he learned of "buys" in certain of the materials commonly used by the company and took advantage of them regardless of the amount in stock.

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[1] See Chap. 19 for detailed description of control methods in the pin and coat-of-arms department of this company.

Prepare a plan of materials control suited to the needs of the Belmont Jewelry Company.

PROBLEM 54 ELECTRIC PRODUCTS, INC.

On October 11, 1961, Mr. William Schlora, supervisor of the engineering department of Electric Products, Inc., observed a large shipment of ACV [2] fabricated spacers arriving at the plant. He telephoned Mr. Harold Swallow, the company's superintendent.

MR. SCHLORA: What's the story on the shipment of ACV fabricated spacers that just arrived? You knew we discarded that design on October 1, 1961, in favor of a casting. There are enough fabricated spacers on this shipment to last us the next two years.

MR. SWALLOW: First, let's get one thing straight. No one told me about discarding the ACV fabricated spacer on October 1. As for ordering a two years' supply of them, I don't know anything about it. We usually order ACV spacers in five- or six-month quantities.

MR. SCHLORA: What do you mean, no one told you about discarding the ACV fabricated spacer? We have already made 12 ACV motors with the new cast spacer. You've seen them yourself.

MR. SWALLOW: Yes, I've seen some ACV motors with cast spacers, but I understood they were trials of a new design. We have been making the ACV motor for three years now, and you have been talking about redesigning it for the past year and a half. We make a couple of motors with cast spacers and I'm supposed to know we have changed to a new design. What do you think I am, a mind reader?

MR. SCHLORA: All right, so you're not a mind reader, but how do you account for ordering a two years' supply of the fabricated spacers? I didn't know we carried ACV spacers in stock.

MR. SWALLOW: We have carried a five- or six-month stock of ACV spacers since last November. I told you I don't know anything about ordering a two years' supply of them, but I'll find out.

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[2] ACV designated the company's alternating-current motor with variable speed.

MR. SCHLORA: Well, it would have been a lot simpler scrapping a six months' inventory of those parts than it's going to be with a two years' supply.

MR. SWALLOW: Who said anything about scrapping them?

MR. SCHLORA: I did.

MR. SWALLOW: Mr. Heffernan is going to have something to say about that.

Later both men arranged to meet with Mr. Heffernan, the company's vice-president in charge of manufacturing.

Electric Products, Inc., located in Pittsburgh, Pennsylvania, was a large, well-known manufacturer and distributor of electric power equipment. Distribution and service divisions of the company were located in principal cities throughout the United States. In 1958 the company added an alternating-current motor with variable speed to its line of electric motors. Prior to this time the only variable-speed motor the company had manufactured was a direct-current motor. Motors with variable speed were usually made up on a special order for customers who specified their requirements. In addition to a direct-current motor with variable speed, the customer generally had to purchase a converter unit which Electric Products, Inc., also manufactured. The converter unit was necessary where alternating current was the source of power available. Alternating-current motors with variable speed had been produced in limited quantities by a few European manufacturers. Electric Products, Inc., was the only American company engaged in its manufacture. The company manufactured the ACV motor in four sizes: 5, 10, 15, and 20 horsepower. Speeds on the motor could be changed by moving a projection on top of the spacer which adjusted the brushes on the commutator to cause the motor to operate at various speeds. The spacer supported the brush yokes and brush shifting devices.

The ACV motor was sold to customers for about $1,400. In 1959, the combined sales of the four sizes of ACV motors were $64,000; in 1960, $73,800. With a production cycle of 25 weeks required to manufacture an ACV motor, 1961 production schedules called for starting one motor in production each week. In July, 1961, there was a backlog of five months' customer orders that had not been started in production when Mr. Alex Shea, the company's sales manager, advised Mr. Swallow to start two ACV motors a week in production. This was to be accomplished as soon as practicable.

Shortly after the large shipment of ACV fabricated spacers had arrived at the Electric Products company, Mr. Heffernan met with Mr. Schlora and Mr. Swallow. The following conversation took place.

MR. HEFFERNAN: I understand we have ordered and received a two years' supply of ACV fabricated spacers. Mr. Schlora tells me that the ACV spacer has been redesigned as a casting and that the fabricated parts never should have been ordered. Gentlemen, that shipment of fabricated spacers represents a cost of $18,000. If we've made a mistake I want to know why. We also have to decide what we're going to do with these parts. We've had several customer complaints on the ACV motor, and it's important that we make the right decision.

MR. SWALLOW: First of all, no one has ever told me that we had decided to change from a fabricated spacer to a casting on the ACV motor. I've been aware that the engineering department has been experimenting with a casting that combines the spacer and end shield of the ACV motor, but contemplated design changes aren't uncommon around here. Hell, I could spend all my time in the engineering department discussing changes that the engineers would like to incorporate into practically every motor we make, but I've got other things to do. I also know Mr. Schlora had a few ACV motors made with new cast spacers. We rushed these motors through ahead of our regular production but then went right back to our regular production with the fabricated spacers. We make a hundred other motors besides the ACV motor. Someone has to tell me when we're going to make a change on one of them.

MR. SCHLORA: But Mr. Swallow knew we had been receiving customer complaints on the design of the spacer on the ACV motor. We weren't experimenting with a new design, we had a new design. I assumed Mr. Swallow knew we were continuing with the fabricated spacer only until we had the proper opportunity to put the casting into production.

MR. SWALLOW: We have been receiving reports on customer complaints on the ACV motor since January, 1960. As you know, Mr. Heffernan, when a customer complains about one of our motors he is contacted by a representative from our local service division. The service representative notes the defect and if he considers it our liability, the motor is repaired by our local service division without charge to the customer. A report on the nature of the defect and how it was repaired is written by the service division and forwarded to Mr. Schlora. Mr. Schlora sends me a copy of these reports, and I've probably read 25 of them on the ACV motor. The complaints did not fall into any clearly defined pattern until just recently. I don't think we knew until March, 1961, that the spacer was the source of trouble. At that time service divisions informed us that the fabricated spacer tended to warp out of shape under operating conditions. After an ACV motor was disassembled to check the source of a customer's complaint, the service divisions had noted there was considerable difficulty in reassembling the parts.

MR. SCHLORA: When we first began to receive complaints on the ACV motor, the engineering department knew that the trouble could be attributed to the spacer. The fact that the fabricated spacer tended to warp out of shape was only a minor consideration. The important factor was that the design of the spacer made access to the brushes almost impossible without disassembling the motor frame. Normally a customer could expect to change the brushes on a motor about once a year. On the ACV motor if the customer had to change the brushes only once a year, he might not have complained about the inaccessibility of getting at the brushes. When the customer had to change brushes every three months, then he did complain.

We had been purchasing our brushes from the same supplier for many years. The supplier had always been reliable. Actually, selecting the proper brush for a particular motor is more an art than a science. We decided on a brush that appeared to satisfy all the requirements for an ACV motor, and the supplier manufactured a brush that met our specifications. What went wrong with the brushes, I don't know. Either we selected the wrong brush, or our supplier's brush lacked some intangible quality. In either case the brush we installed on our ACV motor had very poor wearing qualities. The brushes lasted about three months in operation. Our service divisions replaced the worn brushes but with new brushes of the very same type. Instead of the customer changing brushes once a year, he was doing it every three months. The fact that our ACV motor was poorly designed was impressed upon our customers every three months when they required new brushes. We solved the brush problem in November, 1960. Our service divisions were supplied with an improved ACV brush, and subsequent replacements on motors in the field were made with the new brush. The new brush, of course, was installed on all the motors we were making here at the plant.

We started redesigning the ACV spacer in March, 1960, and completed the design in June, 1961. The new spacer is a casting which combines the spacer and the end shield into one unit. The new design makes access to the brushes relatively simple and should eliminate any possible customer complaint on that score. The principal reason we decided on a casting was a cost consideration. The fabricated spacer costs about $250, whereas the cast spacer and end shield together will cost about $150. We were only waiting until we had a large enough order to put the new design into effect. In June our sales department received an order for 12 ACV motors from the Baxter Machine Company in Fort Wayne, Indiana. The Baxter Company indicated that if the 12 motors were satisfactory they would order 15 more. This gave us the opportunity we were waiting for. We had 12 castings made up on special order. I arranged with Mr. Swallow to push our regular production back and to rush through the 12 ACV motors with the cast spacers. We completed the Baxter Company's order in September and last week received the second order from the company for the additional 15 motors. The Baxter Company potentially may order as many as 40 ACV motors a year from us.

MR. SWALLOW: Last July, Mr. Shea, the sales manager, advised me to increase production on ACV motors to two motors per week. I assumed this was to take up some of the five-month backlog of orders in anticipation of increased sales. However, there was no indication that increased sales might result directly from the 12 ACV motors we rushed through for the Baxter Company. We had been scheduling one ACV motor each week, and I told Mr. Shea it would probably be about eight weeks before we would be able to step up production to two motors per week. I made out a "production schedule change" notice for the production control department. Mr. Schlora received a copy of this notice.

Mr. Alec Garner, who is my production control supervisor, had instructions to make the necessary arrangements to meet the increased production quotas. Somehow one of Mr. Garner's stock clerks got confused when told to order enough spacers to start two ACV motors in production each week. The clerk had previously been ordering a 20-week supply of the spacers; five of each of the four ACV sizes, or a total of 20 spacers. Previous production schedules had not indicated which size ACV motor was to be started each week, but over the past two years production had been nearly equally divided between the four sizes. There had been no problem of an insufficient supply of spacers for any particular size. The fabricated spacers were purchased from the Jones Metal Company in Allentown, Pennsylvania. Deliveries of the spacers from the Jones company had been averaging about 12 weeks. The new production schedule of two ACV motors per week did not specify what sizes the motors might be each week. The stock clerk apparently wanted to remain on the safe side and ordered 80 spacers; 20 of each size.

MR. SCHLORA: That error the stock clerk made isn't something new. The stock clerk is usually some boy or girl just out of high school who is put on the job because everyone thinks it's a simple job. The department has a file of index cards corresponding to all the parts we purchase. The stock clerk is taught to look up a particular card in the file and to write out an order form for the corresponding part. The index card the clerk used to order the ACV fabricated spacer probably read "Spacer-ACV motor. Four sizes: 5, 10, 15, 20 horsepower. Order from the Jones Metal Company." The clerk doesn't know that one spacer costs about $250 and when he places an order for 80 of them that he is dealing with about $20,000. Stock clerks have ordered too many parts on several occasions, only this time it's a part we have changed.

Mr. Shea told me before this meeting that the increased production schedule of two ACV motors per week is not a permanent change and we will probably go back to the one motor per week schedule. It may take us about a year and a half to use up the 80 fabricated spacers.

MR. SWALLOW: We order hundreds of parts every week. We make spot checks on the stock clerk's orders, but it's a physical impossibility to check on every order. Maybe putting the cost of the part on the index card might help. I didn't know Mr. Shea intended to go back to one ACV motor per week.

MR. HEFFERNAN: I don't understand it. You both read the same reports on customer complaints. You both see the same production schedules and changes. You both are in contact with the same sales department. Then we end up with a year and a half's supply of an outmoded part. Do either of you gentlemen have any suggestions as to what we are going to do with the fabricated spacers?

MR. SWALLOW: We could use them up and suffer out possible customer complaints. We could scrap them, stop producing ACV motors, and wait two or three months for a supply of cast spacers. A third possibility to consider might be to strengthen the spacer externally to retard its tendency to warp.

MR. SCHLORA: I don't know where Mr. Swallow gets his ideas from, but you can't consider strengthening the spacer externally. I designed the motor. I know the engineering problems. It's not the spacer's tendency to warp out of shape that is the source of trouble. We are going to have the same tendency in the cast spacer. The design of the spacer was the source of trouble. I've explained that.

The engineering department did not know that ACV spacers were ordered in six-month quantities. The company has only been making about 50 of the motors a year. We assumed that any decision we made to change the design of the ACV motor would not have to be tempered by the number of spacers we had on hand. If it was a question of a six months' supply of spacers on hand I might go along with Mr. Swallow's suggestion to use up the supply. With a year and half supply, I suggest the only alternative is to scrap them and go to the new design.

QUESTIONS

1. What action would you suggest be taken with respect to the 80 fabricated spacers?
2. What action would you recommend to improve parts inventory control for the future?

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QUALITY CONTROL

UNION RUBBER COMPANY

1. A COMPANY IMPROVES QUALITY AND INCREASES PROFITS

The Union Rubber Company was experiencing severe competition, decreased demand for its products, low earnings, and pressing bank loans. Consideration was given to lowering the quality of the product as a means of effecting a reduction in price and thereby increasing sales volume and profits. After a thorough study of the factors involved in such a change of policy, the plan was rejected. The president decided that maintenance of high quality was essential to the company's future success and that it was possible to maintain quality and at the same time reduce costs of output. A comprehensive plan for securing these results was worked out. It included improvements in processes, careful control of capital expenditures, payment of bonuses for quality maintenance, and shortening of work shifts. As a result of these measures, quality control was secured and costs were lowered to such an extent that sales volume was more than doubled, profits were increased, and the bank loans were retired.

2. IMPORTANCE OF QUALITY CONTROL

The need for creating and maintaining definite standards of quality in products manufactured is self-evident. National advertising of branded goods has, of course, tended to intensify this need. Reputation for uniformity and dependability of quality of output is in many cases one of the most important assets a concern can have. Appreciation of the value of such good will has caused many manufacturers to build up quality reputations and then to guard them jealously.

3. ESSENTIALS TO QUALITY CONTROL

Effective quality control focuses on the protection of the company's reputation with customers and on prevention of production output of substandard quality. The gain from the establishment of consumer confidence is in the interest of sales enhancement. By preventing any production that fails to meet standards, costs of production of standard quality are kept to a minimum. This dual objective of quality control has received wide recognition in industry. This dual-purpose approach to the quality function involves several essentials: definite standards for quality measurement, definite fixing of responsibility for quality of output, inescapable routine to ensure regularized measurement of results, systematic determination of responsibility for any failure to meet quality standards, early determination of causes of any failure to meet quality standards, and prompt action to remedy these causes and prevent their recurrence. Unless some one person or group of persons is specifically charged with responsibility for quality control, everybody's business becomes nobody's business and quality suffers.

Unless definite quality standards are carefully worked out and formulated, measurement of quality becomes a matter of human judgment, and quality is sure to suffer. The "matching" of piston and connecting-rod assemblies in gasoline-motor production is a good example of this principle. If a gasoline motor is to run smoothly, it is necessary that the weights of reciprocating parts balance as closely as possible. It is common practice, therefore, after pistons and connecting rods have been assembled, to sort them as they come from their assembly lines on the basis of weight. It would be a tremendous task, however, to sort out for one motor eight such assemblies having exactly the same weight. In practice, these assemblies are sorted into classes, all assemblies within a class having approximately the same weight. Thus, solution of the problem of just what assemblies are to be included in a class will have to be left to the judgment of the "matcher" unless definite limits for each class are worked out and established as standards. With such standards, matching requires no judgment on the part of the worker. All that is needed is close attention to a weighing scale and care in placing the weighed parts in the proper class bin as predetermined by the standard matching scale. Often, to decrease the possibility of error, the weighing scale, instead of being calibrated in usual avoirdupois units, is marked off in divisions corresponding to the standard matching scale. The fixing of such standards and their use as a basis for balancing an automobile motor ensure much higher quality than would result from leaving matching to the judgment of the operative.

Quality standards are of little avail unless they are consistently applied. To assure such application, it is important that a routine making for their utilization be employed. Here, again, the production of automobile motors furnishes us with an illustration. After motors are assembled, they are often set up on "blocks" in the factory and run to check their performance before they are mounted in the chassis. Such testing goes a long way to assure quality in motor operation. Some companies so test every motor produced, and to make certain that every motor goes through the test, the motor assembly line empties into the block testing room. The testers in this division are then required to chart a full report of each motor's performance, and the report, bearing the number of the motor tested, is attached to the motor as a basis for future reference of the inspector who finally releases the motor for chassis assembly.

Such a testing procedure is costly, and some manufacturers might feel that the accuracy of motor assembly was sufficient to render block testing of every motor unnecessary. In such a case, block testing would be done on a sampling basis. Only occasionally motors would be taken from the assembly line at the block testing division. Such a sampling test would be expected to have two results: enough motors would be tested to measure the general quality of the assembly work, and the tests would also serve as an incentive to accurate performance on the part of assembly men. To assure the efficiency of sample testing it is necessary, however, to provide a definite frequency with which tests are to be made. The absence of such a routine would lower materially the beneficial results of the testing procedure.

4. COST OF QUALITY CONTROL

This last example illustrates the importance of the cost aspect of quality control. Ordinarily it is not difficult to make sure that a minimum of defective finished product leaves the plant. Sufficient application of rigid inspection standards ordinarily will bring about such a result. The cost of attaining such quality may, however, be entirely out of proportion to the value obtained. Inspection in the production of a $10,000 automobile should be a very different procedure from inspection of an $1,850 car. Certainly a company making $10,000 automobiles should block test every motor and probably should test each motor on the road by installing it in a test chassis and driving it under severe operating conditions before it is placed in its own chassis. Such a road test would call for an expenditure unwarranted in the case of the $1,850 car, and sample block tests should assure quality that is commensurate with the quality expected of a finished product of that class.

Degree of quality desired or needed is always a question for consideration. It is not good policy to say that the goal to strive for always should be the highest quality. It is much better to determine carefully just what quality requirements are desirable in terms of cost of production, the use to which the product is to be put, and price in a competitive market. Upon the basis of such conclusions, quality standards should be set.

The following is a graphic example of the results of lack of proper consideration of quality requirements. The superintendent of a shop doing a high grade of job machine work was asked by a business acquaintance to make a flat cast-iron plate 3 feet square. The buyer said he did not care much how thick the plate was, ½ inch to 1 inch would be all right, but that he did want the plate flat. The shop superintendent asked how flat the plate should be, and his friend said he wanted it "absolutely flat." The superintendent said he would do his best. About 10 days later the plate was finished and the buyer called at the shop with a truck for it. He looked at the plate and said that it seemed "fine" and wanted to know the bill. The amount was a trifle less than $200. Astonishment does not fully describe the buyer's reaction, nor protest adequately characterize his reply.

As a matter of fact, everyone was at fault in this incident. The buyer wanted a metal plate on which to place a stove in his warehouse office. The floor was irregular, and he had experienced difficulty in leveling up the stove. To his mind a flat surface would remedy the trouble and a cast metal plate, flat on top, seemed the obvious answer.

When, however, he told his friend that he wanted an "absolutely flat" plate, his statement, from the standpoint of quality, had a meaning to the superintendent which the speaker little guessed. Actually, absolute flatness is most difficult, if not impossible, to attain. To the shop superintendent, flatness was a matter of relative degree, and absolute flatness represented a condition attainable only by means of scientific methods and utmost skill in workmanship. The shop superintendent had done his best, and with excellent equipment and skillful personnel had turned out a job of which he was justly proud. The $200 charge was modest considering the work involved in the job and represented little profit to the shop. When he was informed, however, that his friend wished the plate as the base for a warehouse stove, his shock was no less great and his language no less picturesque than that of his friend.

The whole ridiculous situation grew out of failure to determine just what degree of quality, in this case flatness, was desired in terms of the use to which the product was to be put, and then neglect to set a standard of quality commensurate with the degree called for. While this incident is an exaggerated example of the importance of setting quality standards in terms of purpose of the product, cost to produce, and market price, it does involve principles of quality control common to most manufacturing situations.

5. THE CONSTRUCTIVE ATTITUDE TOWARD QUALITY CONTROL

Analysis of the degree of quality desired is important because high quality means high cost. But whatever the standard of quality desired, one of the best methods of keeping down the cost of producing that quality is to be found in what might well be termed a preventive policy concerning quality control. Inspection of materials, parts, and finished product will prevent putting defective products upon the market. Only in an indirect way, however, will it prevent the performance of defective work. It is like locking the garage after the car has been stolen. It is much better policy to make the theft impossible.

Preventive quality control is designed to preclude the production of parts or products that do not meet predetermined quality standards. When a produced part does not measure up to quality requirements, it represents a partial or total loss of the materials, labor, and much of the overhead involved in the production of the part. The principle of preventive quality control is obvious; if no defective parts are produced, the costs incurred in the production of a defective part are eliminated. While the complete elimination of all defective output may not be attainable or economical, the practice of preventive quality control will go far to hold losses from substandard output to a minimum.

Procedures employed in preventive quality control range from exceedingly simple ones to more sophisticated statistical devices. When usage of a machine produces wear that makes it difficult to obtain standard quality output from the machine, repair or replacement of the machine becomes an obvious cost necessity. Close observation of the performance of the machine will make it possible to determine the approaching need to replace or repair the machine, and prompt action can forestall the incurring of losses from substandard production resulting from use of worn equipment. Statistical quality control extends this simple concept by means of sampling procedures. Determination of the approach of conditions that will result in nonstandard output is the goal.

Quick identification of the causes of any failure to meet standards makes possible prompt measures to eliminate these causes. This will reduce the production of defective products, a quite different result from that of inspection which goes no further than to say that this item does not meet specifications and must not get into the consumer's hands or must not go into stock for assembly into finished product. Prevention of uneconomical nonstandard output is likely to be the best way of producing quality at minimum cost. The carrying out of a policy of preventive quality control requires understanding, acceptance, and practice of the principle involved by all concerned. This may be the responsibility of a quality control department, but no quality control department actually can produce quality. This is a responsibility of workers, supervision, management.

6. A COMPANY UNDERTAKES QUALITY IMPROVEMENT

The Union Rubber Company of Akron, Ohio, employed about 400 workmen in the manufacture of tires and other rubber products. The president of the company had had experience as a factory worker, a salesman, and a reorganizer of industrial concerns. When earnings of the company showed signs of becoming seriously low, this executive sought a solution in keeping with what he believed to be the company's responsibility to its employees and its stockholders. While lowering the quality of the company's products would have been an easy way of reducing prices to meet competition, the president concluded that a sounder means of building up a permanent demand was to maintain quality or, if possible, improve it, and at the same time seek to lower operating costs.

7. THE EXECUTIVE BONUS SYSTEM

One of the first measures undertaken in the president's program of quality control was the institution of a system of bonuses for the attainment of quality production. The quality bonus system was designed to apply to practically every worker and supervisor in the plant.

Fourteen supervisors were included as eligible for bonus earnings: the plant engineer, assistant superintendent, draftsman, time-study man, chief chemist, assistant chemist, chief mechanic, general factory foreman, mill-room foreman, tube-room foreman, two foremen in charge of the plant's tire-building divisions, foreman of the air-bag department, and foreman of the wrapping room. The management ranked these men according to its opinion of the relative importance of what they would be able to contribute toward the lowering of quality costs, basing judgment on long experience and taking into account both the capacities of the individuals and the nature of the work for which they were responsible. The plant engineer was judged the most valuable man in the group because he had the greatest opportunity to improve mechanical equipment and thereby increase quality output per worker. He, therefore, was allotted 1,000 points, the highest point rating. A total of 10,000 points was divided among the 14 members of this group.

When experience with the plan showed the management that a supervisor had increased his value to the company, his point assignment was increased to reflect this value, and the total number of points assigned to the group would be increased by the same amount. This prevented the success of one individual from lowering the point rating of the other supervisors in the group. Likewise, the point rating of any future additional members of the supervisory group eligible for bonus would be added to the total number of points assigned to the group.

The point ratings were used in the computation of each supervisor's bonus earnings. Each day a standard budget was established for the day's production in terms of perfect tires finished. The daily budget figure varied with changes in size and types of tires needed and with total demand. If the actual production of a department was greater than the standard, the department supervisor earned a bonus. If department output was less than standard no bonus was paid. For example, if the day's budgeted production was 5,000 tires and only 4,850 were cleared through the wrapping room, the foreman of the wrapping room made no bonus, although the foremen of those departments which had exceeded the standard for that day did receive bonuses. If, however, the wrapping room cleared 5,100 perfectly wrapped tires on that day, the foreman of that department earned a bonus because he had exceeded his budget standard. Thus, the bonus of a departmental supervisor was dependent on his ability to exceed the budgeted daily volume of perfect tires in his own department. Supervisors whose work was not limited to one department received bonus payments in proportion to the extent that the plant as a whole produced more than the budget standard of good finished tires for the day.

The amount of daily bonus earned by a supervisor depended on two things: the amount of production of his department in excess of the day's budget, and his point rating as a member of the supervisory group. Thus, the plant engineer, who had the highest point rating, received a greater bonus payment for exceeding the daily budget by 5 per cent than did the foreman of the wrapping room. The management considered that the responsibility of the plant engineer for quality production throughout the plant as a whole was greater than that of the wrapping room foreman in his one department. Therefore, the bonus reward to the plant engineer was greater for the same amount of excess production.

Figures of perfect production in all departments were posted daily, and supervisors could tell at once whether they had earned a bonus and the amounts of such earnings. Supervisors met at least once a month and discussed methods of increasing quality production by means of better process or mechanical control.

The bonus for executives focused attention of all supervisors on the new program. As rewards were calculated on volume of output, it might be said that the bonus was paid for quantity of output rather than quality. True, quantity was the basis of calculation, but it was quantity of tires of standard quality. Also, the basis for computing individual point ratings was relative responsibility for quality of output. The form of this bonus put the emphasis on quality without setting up a tendency to sacrifice quantity in the interest of quality.

Basically, it should not be necessary to offer bonuses to executives in order to stimulate them to their best effort. Furthermore, executive bonuses often tend to injure teamwork, which is of great importance at the executive level. In the case of the Union Rubber Company, the bonus for executives was probably not only desirable but also fundamental to the success of the company's program. The business faced an emergency. Quality was to be the answer to that emergency. The bonus for executives kept that emergency need clearly before every member of the organization each day.

B. WORKMEN'S BONUSES

The application of the quality bonus plan to workmen may be illustrated by the methods used with the tire builders. These men had been paid on a piecework basis with a guaranteed minimum daily rate. The quality bonus plan called for the payment of an additional sum for sustained output of perfect tires. A standard daily output was established, and whenever a tire builder's daily output for a period of 25 consecutive days averaged standard or better, he was given as extra compensation a bonus of 5 per cent of his regular earnings for the period. If he maintained this rate of perfect output for the following 25-day period, his bonus rate for the second period was increased to 7½ per cent. For a third consecutive 25-day period, the rate was raised to 10 per cent, at which point it was maintained as long as he continued to attain standard quality production.

A cumulative bonus of this type either is powerful as an incentive or is entirely ineffective. The guaranteed minimum daily rate would tend to make the new quality bonus effective, provided the guaranty was set reasonably high. The tire builders might be expected to take the attitude that they had much to gain and nothing to lose. However, the cumulative aspect of the plan placed a great premium on continued accomplishment of the standard and yielded a very substantial reward. A worker who did not earn a bonus might be disgruntled. Such an effect would be very undesirable. In this case, it was expected that the minimum guaranty would serve to prevent any great amount of such adverse reaction. As an incentive to high quality of ouput without sacrifice of volume, the bonus to tire builders proved to be effective.

9. THE CALENDAR DEPARTMENT BONUS

In the calendar department, the quality bonus took a different form. Because of conditions over which the workers had little or no control, a certain amount of defective output was bound to occur for which the workers could not fairly be held responsible. Slight variations in fabric and compound, weather conditions, and temperature and humidity within the plant sometimes were of sufficient influence to cause defective output. It was, therefore, necessary to make provision for these factors, and the management set up a standard waste allowance of 2½ per cent of the total weight of the fabric going through the department. Care on the part of workmen in threading fabric into calendars and attention to details of operation enabled them to reduce somewhat the amount of poor-quality output. Whenever waste in the department was by such means kept below the standard allowance, credit for the amount thus saved was divided between the employees and the management according to an established scale. This device served to keep the quality of workmanship in this department at a high level.

10. INSPECTION

As a result of the utilization of these incentive devices, the management of the Union Rubber Company was able to depend in large measure on the employees to maintain quality output. However, in order to make the incentives effective in this respect, as well as to provide a check on results obtained, systems of departmental and finished product inspection were maintained. These inspectors were trained to detect substandard output, to determine causes, and to refer all such situations to the individuals or departments that could develop remedies. In addition to departmental inspections, an exhaustive inspection of a sample of each week's output was made by the following group of men: the general tire superintendent, the chemist, the superintendent of the wrapping department, and the man in charge of construction and design. Fifty tires that were ready for shipment were taken from stock, the packages broken open, wrappings torn off, and the tires minutely examined, even to such details as labels, striping, and medallions. In this way careful check was maintained on quality, and the results obtained from the use of quality incentives were known. In the opinion of the company executives, the effectiveness of the quality control devices applied to workers and supervisors made it practical to depend in large measure on the workers themselves to secure high-grade output.

11. COST REDUCTION

In addition to the bonus plans adopted, other means important in keeping down costs in the Union Rubber Company plant were devised by the production manager and plant engineer. Tasks were made easier as the result of changes in production methods. Typical of such efforts was the development of a mechanical device for breaking open tire molds. This task had been done by hand, and when so performed the work was arduous. The mechanical mold opener eliminated the strenuous physical exertion and, in addition to reducing materially the fatiguing effect of the work, speeded up the operation. The result was greater output per worker and better output as well, with the reduction of carelessness caused by fatigue. Other improvements in process had similar results. In addition, careful attention to causes of accidents and process interruption resulted in changes which reduced such costly occurrences to the minimum.

Savings in operating costs were obtained by installing insulation which reduced steam losses and increased the efficiency of vulcanizing equipment. By careful attention to motors and electrical devices, the plant engineer raised the power factor to 98 per cent. He also made it possible to decrease coal consumption from 29 tons per 24 hours to 21 tons in spite of the fact that production and steam demand doubled. As a result of these improvements, his own bonus was increased, and in many instances workmen were enabled to increase their bonuses as well.

12. EFFECT OF SHORTENED WORKDAY ON QUALITY AND COST

In the summer, a change was made in hours of labor for the men employed in the vulcanizing department, commonly called the "pit." In this department the atmosphere was hot and humid. Furthermore, the work called for a considerable degree of skill. Tire demand was heaviest in the summer, and 24-hour operation seven days in the week was usual. Three eight-hour shifts had been employed, and the results obtained had not been satisfactory from the standpoint of either quantity or quality of output. The substitution of four six-hour shifts was therefore tried, with the following results:

1. The number of workers employed in the department was increased 33⅓ per cent.
2. Output was brought up to budget standard, many days showing a perfect score of quality output. At no time did failure to make standard exceed 5 per cent, an output much better than had usually been attained with the three eight-hour shifts.
3. Absences, which had previously been a frequently disturbing factor, were almost eliminated.
4. Labor cost per unit vulcanized declined 8.2 per cent.

The reduction in labor cost was computed from figures for two months during which conditions were identical, with the exception that in one month three eight-hour shifts were employed while in the other four six-hour shifts were employed.

The experiment with six-hour shifts in the vulcanizing department was watched carefully. The results obtained both in busy seasons and slack seasons were so favorable that it was decided to extend the four-shift system to other departments of the plant. This was done, and within three months practically the entire plant was on a six-hour-day basis. It was expected that the plan would be further extended to include the salaried personnel.

The direct savings resulting from the extension of the four-shift plan were less easy to compute than those which had been obtained in the vulcanizing department because of the difficulty of finding exactly comparable periods on the eight-hour and six-hour bases. The management stated, however, that the savings were at least equal to those secured in the pit. No change in piece and day (not hourly) rates was made when the six-hour shift was installed.

The satisfaction of the management with the six-hour shift plan is explained in the following statement of one of the company's executives.

> We have found that four six-hour shifts not only enable us to employ 33⅓ per cent additional men, thus giving more men employment, but that the change from three eight-hour shifts to four six-hour shifts per day enables individual workers to perform their tasks better. The six-hour day, coupled with the high rates paid in our factory, enable our employees

> who are working six hours a day to earn within 7 per cent as much as the highest paid worker did when working eight hours per day.[1]
>
> Then, too, there are many sociological benefits derived from the six-hour day.
>
> 1. It provides more spare time each day which the worker can use for recreation or private hobbies of whatever sort.
> 2. It most likely will lengthen the years of industrial life of the worker in that he seldom reaches the point of fatigue, and thus he will wear out more slowly than in the past.
> 3. Monotony, which is a heavy accusation hurled at modern specialized industry, is relieved after only six hours, and then the worker may in other private spare-time efforts vary his activities sufficiently to avoid any unhealthy mental attitude that might come from too much of one thing.
> 4. Employment of more men is of course obvious, in that four shifts are employed instead of three. Almost any social calamity can conceivably develop from large-scale unemployment, which can be substantially bettered by shortened working hours for an increased number of workers.
>
> To the employer, benefits in the form of better workmanship, better attendance, and better health of workers should result from shortened working periods. These advantages should be sufficient to provide the increased hourly wage rates that a shop would usually be obliged to set up if a six-hour day became standard. Union's existing liberal wage rates have taken abundant care of the shrinkage in hours. In addition Union realizes a steady flow of perfectly made merchandise from this plan. Union can thus operate continuously seven days per week, through the hot peak season, even with its heavier tire sizes, and by so doing have its employees healthier and happier, and meet its heavy sales demand.[2]

As a result of the measures described in the case, the Union Rubber Company was able to control the quality of its product and, while so doing, lowered costs to such an extent that sales volume more than doubled, profits were increased substantially, and bank loans were retired.

13. SUMMARY AND CONCLUSIONS

The Advantages of a Quality Program. The comprehensiveness of the action taken by the management of the Union Rubber Company to secure high quality of output is the outstanding feature of this case. Practically all companies employ some device or devices to ensure the desired quality of product. Few companies employ so complete and carefully integrated a quality program as that described in this chapter. It is important to realize how universally the contributors to the production process can influence quality of output. Proper raw materials are obviously essential. This case shows that plant equipment and working conditions are of equal importance. It is also clear that good workmanship can be secured at low cost and without sacrifice of volume if suitable incentives are used. The results of directed effort and coordination on the part of all members of the supervisory force are demonstrated. The company had a program that covered most of the elements of production that could influence quality. From first to last, this integrated program was constructive in its aims and devices. That is why company management found its efforts in behalf of high quality so effective in reestablishing profits.

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[1] When questioned, the executive explained that what he meant to say was that the average earnings were within 7 per cent of the earnings of the highest paid worker.

[2] It should be noted that the six-hour, seven-day shift gives a substantial reduction in overtime when compared to the eight-hour, seven-day shift arrangement.

Inspection and Disciplinary Action. Inspection is the most common method of assuring quality of workmanship. The usual means of making inspection effective is disciplinary action in the form of reprimand, reduction in pay, layoff, or in serious cases, discharge. Such disciplinary action is expected to have a corrective effect upon the workman involved and upon his fellow workers as well.

The Importance of the Foreman. The effectiveness of disciplinary action for control of quality depends largely on the skill with which the situation is handled. Usually this is a matter of foremanship. An intelligent foreman can often make disciplinary action constructive. Such results are, however, all too uncommon. Unintelligent disciplining of a work force destroys shop morale and precludes any beneficial results from the action taken.

Preventive Quality Control. Recently, preventive measures have tended to take the place of remedial efforts in quality control in many factories. Statistical applications have been devised which make it possible, for example, by studying the output of a machine to foretell when the machine should be shut down for tool grinding before tool wear becomes excessive. The fundamentals of this procedure are rapidly receiving wide application in a great variety of quality control situations.

Executives who advocate preventive measures believe that creating within the work force a desire to do good work and providing the means and methods for doing work well are much more profitable than prescribing punishment after unsatisfactory work has been turned out. Such executives insist that workers be provided with the best of working conditions, that they have the proper tools always in proper condition, and that they be thoroughly trained in the most efficient methods of task accomplishment.

Creating conditions and providing means favorable to excellent workmanship is the first step; the second is providing positive incentive in the form of a reward for making the most of good working opportunities. The quality bonus is a typical incentive. Such bonuses have been worked out and found successful in a variety of circumstances. Occasionally they have been tried without the preparatory conditioning of workplace, tools, and methods, including the means of measurement, and under such circumstances usually have failed. Intelligently devised, and applied under suitable conditions, quality incentives have proved themselves profitable, time and time again.

Ten Years After. Some 10 years subsequent to the Union Rubber Company action described in this case, a field researcher revisited the company. His purpose was to get a longer range appraisal of results of the program installed years earlier. On first consideration some of his findings are unexpected. Thoughtful consideration of the industrial, economic, and social changes of the past decade throws a somewhat different light on the situation. Here, we will report what he found. Appraisal of these findings will be left for readers.

The Union Rubber Company has prospered during this period of rapid economic growth. It has become a profitable, expanding, soundly financed business. Its public image is that of a tire manufacturer which confines its activities to the production of premium-quality, higher priced tires selling exclusively to the replacement market. As far as the public is aware its output never is to be found as original equipment on new cars except in the rare case of a few cars selling at "luxury" prices. The company probably enjoys the reputation of producing as fine quality tires as are sold in the United States.

The Union Rubber Company has been so profitable that it has invested excess earnings in manufacturing opportunities unlike tire manufacture. In expanding it has gone into industries where the growth probabilities have seemed unusual. In other words from a financial point of view Union has been phenomenally successful.

Still its major activity is tire production, both passenger car and truck. Its tire plants have been completely modernized and are said to be more automated than is common in its industry. Little unskilled labor now is employed, and practically all the arduous hand labor tasks now are done mechanically. The early development of mechanical mold openers was just the beginning. Labor hours per tire produced have been reduced by about 60 per cent.

With a single exception the plant now works a 40-hour week with three eight-hour shifts. This change was made at the workers' request, and there have been no ill effects on either output per man hour or in quality of output. At the time of the change there was no reduction in hourly or piece rates. Worker take-home pay increased. Although fringe benefit costs have more than tripled, the labor cost as a per cent of total tire production cost has not increased. The change from four- to three-shift operation resulted in a substantial reduction in supervision costs.

The one operation where the six-hour shift operation has been retained is in the pit. Substantial amounts of money have been expended on equipment to make the work in this area easier and the working conditions less undesirable. However, it has proved impractical to hold down temperature and humidity in this area to levels comparable with the rest of the plant. During July, August, and September this department operates on a six-hour shift seven-day basis with time-and-one-half for the Sunday work. Shifts rotate so that every worker works four weeks on each shift during this period. Labor productivity is about 2 per cent lower during the summer months than the rest of the year, and worker take-home pay is comparably lower, but the people employed in the department prefer this arrangement.

A program designed to prevent the production of substandard tires is effective throughout the plant. Statistical methods are employed where appropriate. The quality bonus to supervisors has been discontinued. Quality bonuses to workers have not been changed except in some details where improved measurement of results has been developed. The present management reports that the changes of the past 10 years have been made in response to changes in the industry and within the company itself.

QUESTIONS

1. What was the basic problem of the Union Rubber Company?
2. What policy did company executives adopt in solving that problem?
3. Describe the bonus plan the company devised for its executives. What were the advantages and disadvantages of that plan?
4. What do you think of the idea that executive bonuses are desirable only under exceptional circumstances?
5. Describe the quality bonus system for tire builders. What were its points of strength and weakness?

6. Be prepared to describe and discuss any other quality incentives described in the case.

7. What were the advantages and disadvantages of the shortened workday in the vulcanizing department?

8. Do you think the shortened work shift had equal merit in other parts of the plant?

9. How did the short workday make for better quality in the Union Rubber Company plant?

10. Describe the various other means originally employed by this company to improve quality and decrease cost.

11. Explain the constructive, or preventive, concept of quality control. Is it better than other approaches to the problem? If so, how?

12. Be prepared to discuss the changes made in this company during the past 10 years. In each case suggest conditions of the time that might have been responsible for the change.

PROBLEM 55 MILES SHOE COMPANY

The Miles Shoe Company paid practically all its labor on a straight piece-rate basis. It was proposed that the cutting of leather uppers be put on the basis of a piece rate with bonus to encourage better utilization of raw material.

The plant manager of the Miles Shoe Company, which manufactured soft-soled slippers, was reorganizing certain of the shop departments in anticipation of an increased volume of business during the approaching busy season. For the past two years there had been a steady market shift from felt to leather in medium-grade slippers such as those produced by the Miles Shoe Company. This shift was largely responsible for the critical consideration that was being given the cutting department of the plant.

In this department the cutting of leather uppers was an operation requiring both dexterity and judgment on the part of the worker. As compared with the wages paid, the raw material involved represented a much greater cost. No two hides were exactly alike in size, shape, or quality. The problem in cutting was to utilize every available inch of the hide without including imperfections. Carelessness in the cutting operation could entirely absorb the margin between cost of production and selling price of this grade of slipper.

The cutting operation was performed in two ways, by hand with patterns or on clicking machines with dies. The choice of method depended on the volume of the particular slipper pattern being made. When a sufficient number was to be produced to warrant the investment, dies were purchased and the uppers cut on the clicking machines. When only a small lot of the particular slipper was made, it did not pay to purchase dies and the leather was cut by hand from patterns.

Regardless of the process chosen, the cutters were paid piece rates. The rate for cutting a given pattern was, of course, greater when the operation was performed by hand than when it was done on a machine. These rates had been established with reference to past experience in the Miles plant and wages commonly received on similar operations in other plants in the vicinity. No attempt had been made to fix the rates by means of time or motion studies. Both workmen and management were satisfied with the existing rates.

The cutting room foreman was responsible for the quality of finished parts in his department. An over-all inspection was made of the finished product just prior to packing for shipment. Very few of the company's slippers were returned to it as defective, nor was any considerable volume of imperfect product returned to the workrooms as a result of final inspection. The cutting room foreman was also responsible for proper utilization of raw materials. He made frequent inspection of the scrap that accumulated at the machines and benches and was thus able to note the amount of waste of each workman. During the busy season of the previous year, the duties of the foreman had been so arduous as to compel him to work overtime regularly.

On the basis of past experience, the Miles Shoe Company had established standard costs for each style and size of slipper produced. Thus, when a cutter was assigned a job, he was issued the standard quantity of raw material which the costs sheets showed would be needed. Sometimes he was unable to get the required job out of the standard issue; occasionally there was raw material left over after the lot was cut. The cutting room records charged the standard amount of raw material to the job when it was issued. Any excess or shortage was recorded after the lot had been cut. This raw material saving or shortage was due to two things: the ability and care of the cutter and the degree of uniformity in quality of the leather. Careful inspection and sorting of the hides led the cutting room foreman to believe that the workman was the more important factor of the two.

It had been suggested to the plant manager that raw material would be better utilized if, in addition to the piece rate paid them, the cutters received a bonus based on the amount of raw material saved from the standard amounts issued. It was pointed out that in the present wage system there was no constructive incentive to economical utilization of raw material.

The management decided not to install a bonus. Executives thought that the plant was too small for such a policy. As the volume of work increased, an assistant would be given the cutting room foreman to relieve him of some of his routine duties, such as assignment of work to individual workmen.

Was this the best way of meeting this company's problem?

PROBLEM 56 MICROTROL CORPORATION

Executives of the Microtrol Corporation believed that the company's reputation for producing products of very high quality and dependability was one of the company's chief assets. The company's inspection and testing procedures were elaborate and costly. During a period of rapidly increasing sales the company incurred operating losses. As one part of an effort to reduce high costs, the chief of inspection proposed radical changes in inspection and quality control.

The Microtrol Corporation produced testing and measuring devices which utilized a combination of optical and electronic systems. These high-precision products were used in hospitals as diagnostic aids and in industry for inspection and testing. The company was six years old and had grown rapidly. The management attributed this unusual success to certain unique design features of its products and to care in parts production and assembly. Every instrument produced was given an elaborate and exhaustive test upon completion and before shipment. Users of the company's products almost never found it necessary to have these instruments repaired, adjusted, or recalibrated.

On January 1, 1962, the company's payroll included 160 "direct labor" workers in the parts production departments, 190 assemblers in the two assembly sections, 22 supervisors and foremen, 63 inspectors in the central inspection and subassembly departments, and 6 final product testers. Most of the workers in the parts production departments were skilled mechanics and electronics workers. Optical components were purchased from companies specializing in this field. In the assembly departments the workers were highly skilled people who had been given special training when they were first employed. Inspectors were either semiskilled or highly skilled. Inspectors of mechanical parts required no more than four months of training and experience to become proficient; final instrument testers were technical school graduates with considerable industrial experience in their specialties. The head of the inspection department and his two assistants were graduate engineers.

Most parts were produced in small lots; 50 pieces was a common lot size. A few parts such as fasteners which were common to several products were made in longer runs for stock. When a worker completed an operation on a lot of parts (10 to 60 pieces), he notified his foreman who had the lot moved to the central inspection area. There each part was inspected, and any parts that failed to meet specifications for that operation were rejected. There were very few rejections, and practically no attempt was made to rework rejects. The batch of inspected parts then was moved to the operator assigned to perform the next operation on the part. Upon completion of each operation the part was moved to the central inspection department where the operation last performed was checked by an inspector. Parts that passed the final operation inspection were moved to the finished parts stock room. An average of six operations was required to finish a part.

The central parts inspection department had been established late in 1958. Prior to that time a force of roving inspectors had checked each lot of parts in the production departments after each operation. As volume increased it had become difficult to schedule and control the activities of the roving inspectors, and frequent production delays caused much trouble. Conflicts between an inspector and the worker who had performed the operation were not uncommon. The movement of parts to a central inspection location for check after each operation was designed to overcome these difficulties. The central inspection department was successful in doing this.

Instruments were assembled in lots of 10 to 50 instruments. Parts withdrawn from the finished parts stock room were made up into subassemblies. There were three to eight subassemblies in each instrument. Upon completion of a subassembly lot, the lot was moved to the central inspection department where each subassembly was subjected to a test designed to establish the satisfactory performance of its function in the finished instrument. Subassemblies went to the final assembly department where they were combined with additional parts to make up finished instruments.

A crew of skilled test technicians in the final assembly department gave each finished instrument rigorous tests. Few assembled instruments would meet these tests until the test inspectors made additional adjustments or calibrations. Testers were trained in this work, and such final adjustment was considered to be a normal part of the test procedure. Upon completion of the final test the inspector made up in duplicate a detailed record of the instrument's technical performance. One copy of this report was attached to the instrument for the information of the purchaser. The other copy was retained in the company's files.

During the last half of 1958 and the first nine months of 1959, sales of the Microtrol company doubled. In the factory this was a difficult period. Rapid expansion of the work force and the development of new products resulted in many problems for executives, department supervisors, and foremen. Many new inspectors were added to the inspection and test work forces, and the inspection department constantly found it difficult to handle the increased work load.

For the first time in its existence, this department was plagued by frequent complaints from the subassembly and final assembly departments. A study of these complaints disclosed that frequently parts drawn from the finished parts stock room were defective. Spot checks of the parts being passed by inspectors after each operation indicated that these inspectors were doing their work well.

To meet this critical situation, the chief of inspection added a final parts inspection following the individual operation inspections. Before parts were placed in the finished parts stock room, a group of six inspectors gave each part a final inspection covering all operations on the part. For the first time inspectors found it necessary to reject many parts because they did not meet specifications. Also it was discovered that parts defects never involved the final operation on a piece; the fault always was with an earlier operation.

The nature of parts defects was such that the faults could not be corrected by reworking the defective finished pieces. It became necessary to increase lot sizes for parts production in order to assure assembly of adequate good parts to meet the assembly schedules.

The over-all inspection of finished parts succeeded in preventing defective parts from getting to the assembly departments. But the increase in production and inspection costs remained high. The best estimate of the situation indicated that these costs had increased to 12 to 15 per cent of total cost of each finished instrument.

Checks of the work of inspecting each operation on a part showed clearly that the trouble was not faulty inspection. Also rejects after each operation were less than 1 per cent, no higher than had been experienced before the troubles in the assembly departments had developed. It was found that defects in an operation were caused by something that happened to the part after the operation had been properly performed and passed by the inspection of that operation on the part.

The search for causes of faulty output then moved into the parts production department. What eventually was learned was that new production workers, while they performed their operations satisfactorily, sometimes handled the part or clamped it into their machines in such a way as to injure an earlier operation on the part. Parts lots produced by the older, more experienced operators seldom showed up as having defects at the final over-all parts inspection. However, when the more experienced workers produced parts for products newly put into production, they were as likely to cause injury to preceding operations on the part as were the new workers.

Because of pressures to increase output, the production departments made little headway in solving this problem. It was well recognized that scrap costs were excessive, that production costs were high, and that inspection costs were way out of line when compared to production costs. Yet little was accomplished in solving these problems.

Third-quarter 1961 operations of the Microtrol Corporation resulted in the company's first quarterly loss in three years. Following a prolonged meeting of the company's board of directors, the company president held conferences with the factory superintendent and the chief of inspection. Both of these executives reported directly to him. He told both men "you simply have to get your costs down." He also pointed out that competition was increasing and that he considered the company's reputation for dependable products of high quality the company's most valuable asset. He said that by the end of the year both departments must show a reversal of cost trends.

A month later, the chief of inspection came to the president with a proposal for a drastic reorganization of his department. The essentials of his plan were as follows.

1. All inspection of individual operations on parts would be discontinued.

2. Inspection of completed parts just prior to those parts going into

stock would be continued. This inspection would be the responsibility of a new department to be called the quality control department.

3. The new department would make sample checks of finished instruments before they were shipped. This check would be confined to determination of the accuracy of the performance data on the test record attached to each finished instrument.

4. The test and inspection sections of the subassembly and final assembly departments would be the responsibility of the production supervisors of these departments under the factory superintendent.

5. All responsibility for assuring quality of parts output would be placed with the operating department supervisors under the factory superintendent. Each of the six superintendents would be given an assistant who would be responsible to the superintendent for quality control in the department.

6. Each worker would do his own inspecting. He would be provided with whatever inspection devices the superintendent believed necessary. Each worker would be taught to do the inspection specified by the superintendent. Workers on piece rates would have the standard job times increased to include time necessary to perform the inspection specified for the task.

7. Costs of parts-in-process inspection, the salaries of the new assistants to the superintendents, and the costs of all defective parts output would be charged to the parts production departments. The salaries of the three inspectors in the subassembly department and of the six testers in the final assembly department would be charged to those departments.

8. The new quality control department would consist of a chief of quality control, three assistants, and six final parts inspectors.

9. The chief of quality control would report directly to the president. His responsibilities would include:
   - *a.* Random sample tests of finished product performance.
   - *b.* Inspection of finished parts to detect substandard parts, determine the causes of nonstandard output; work with the production superintendents to eliminate the causes of faulty production.
   - *c.* Advise and assist the superintendents in setting up and operating inspection and constructive statistical quality control procedures in their respective departments. He suggested that he be allowed to nominate men from his inspection department to become quality assistants to the superintendents, but that selection decisions would be made by the superintendents.

d. Train the superintendents' assistants in the principles, procedures, and applications of statistical methods of constructive quality control.

QUESTIONS

1. If you were the president of the Microtrol Corporation, would you adopt the proposal of the chief of inspection?
2. If you were the factory superintendent of the Microtrol Corporation, what would be your reaction to the proposal of the chief of inspection?
3. What steps would you suggest the factory superintendent take to reduce scrap losses and production costs?

22
COST CONTROL

BELMONT JEWELRY COMPANY (R)

1. A DEPARTMENT EXECUTIVE PROPOSES TO ELABORATE A PRODUCTION CONTROL SYSTEM TO INCLUDE COSTS

The president of the Belmont Jewelry Company had employed a new superintendent for the pin and coat-of-arms department of his company. Production in that department had been lagging behind schedule, and it was the task of the new superintendent to straighten out that situation. He did so, and at the end of the first year of his service to the company the department was working smoothly.

Before coming to the Belmont Jewelry Company the superintendent had worked for several years for a company which depended in large measure on production and cost records as aids in the formulation of managerial policy and as means of measuring results. In straightening out the affairs of the pin and coat-of-arms department of the Belmont Jewelry Company, the superintendent had devised a simple system of production control. This system had been improved during the year in which it had been in effect. The superintendent had found it of great value to him and wished to elaborate these records somewhat to include information as to the costs of carrying on the work of the department.

2. AN OBJECTIVE OF MANAGEMENT—PROFITS

It is frequently said that the objective of management is the making of profit. If by that is meant the ensuring of future profits as well as the gaining of immediate returns, most of us will agree. At least it is true that the modern method of measuring success or failure of a business is by means of profit or loss resulting from operations.

3. RECORDS OF BUSINESS PROGRESS

The record most commonly used to tell the story of a company's financial position is the balance sheet. The company's operating success or failure is shown in the profit and loss statement. Both of these records commonly are prepared on an annual basis. By comparing current statements with those of past years, trends can be observed.

These two annual statements can be made to provide information in various degrees of detail. For public consumption they often are the briefest summaries. When prepared for the use of company executives they portray assets, liabilities, income, and expenses in much greater detail. Basically, however, these statements are historical summaries. They are useful for certain purposes. As aids to the making of current operating decisions they often are inadequate—too little and too late.

4. INADEQUACY OF THE OPERATING STATEMENT

The shop executive or foreman finds the usual operating, or manufacturing, statement of rather less value than does the general executive. For shop purposes, such statements are lacking in two respects. In the first place, the information cannot practically be made currently available. Annual and semiannual statements are the rule. Occasionally, a company compiles this information as frequently as once a month. Even in such cases the information has limited usefulness for the operating executive. It is not properly classified or sufficiently detailed for his purposes. For example, it is most rare for such statements to show costs by products or types of products. Such a classification is most essential for production control, and what is more, product costs should, in most cases, be subdivided by operating departments. Lack of timeliness and lack of properly classified detail make the ordinary manufacturing statement of relatively little value to the production executive.

5. IMPORTANCE OF DETAILED CURRENT COSTS

Detailed current information on costs is of major importance in production control. Such information serves two purposes: it provides, in part, the basis for decision making; and, equally important, it helps to measure the effects of actions taken. When sensibly undertaken, the compilation of cost data often is neither excessively difficult nor expensive, and as a usual thing the values gained from a properly devised method far exceed the costs of collection.

6. ACCURACY OF COST DATA

One matter of policy as regards the compilation and use of cost data should be stressed at this point. It may seem an exaggeration to say that in practically all cases it is humanly impossible to determine *exactly* what it has cost a company to produce a product. The statement is nevertheless true. This fact is a matter of practical significance, however, in but one respect: the attitude we take toward mathematical precision in both collecting and using cost data. On the one hand, we might say that if cost data are not exact there is little use in collecting them, for their utilization in control or as a measuring device will be inaccurate and lead to unforeseen and undesirable results. There is a real element of truth in such an attitude. Practically, however, it need not be a matter of too great concern.

When the sun sets, it becomes dark. As yet the mind of man has developed no means whereby we can reproduce, during hours of darkness, the general illuminating effects of sunlight. Yet because we cannot reproduce the full illumination of the sun we do not stay at home. We have developed ways of securing a partial illumination of restricted areas, and by such means we move about and continue our activities long past the sunset hour.

In treating of business costs we do the same. Just because we cannot determine production costs with mathematical exactness and precision we need not go out of business, nor need it be the part of wisdom to disregard costs or fail to utilize such cost data as we can readily acquire. A little light is better than no light at all, both when it comes to driving a car on a mountain road and when one is engaged in controlling the costs of manufacture. The wise executive uses all the information he can readily get, and because he understands their limitations he can use such data intelligently and therefore effectively. There are two extremes to be avoided: the one is to say that because cost data are inexact their use is of little value; the other is to assume that cost data are, or can be made, exact and that they can, therefore, replace experience and intelligence in managerial control.

7. COST CONTROL AS AN OUTGROWTH OF PROCESS CONTROL

The experience of the superintendent of the pin and coat-of-arms department of the Belmont Jewelry Company is a good illustration of the value of a proper attitude toward the collection and use of cost data. A simple, adequate system for controlling the flow of work in the department had been devised and tried out and had proved its worth in use. The superintendent proposed a limited amplification of this control device as a means of better planning for cost reduction and then measuring the effects of changes made.[1]

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[1] It is of absolute importance that the student have at this time a clear understanding of the production control system in use by this company. This can be readily obtained by a restudy of Chap. 19.

8. DETERMINING LABOR COSTS

The process control routine in the pin and coat-of-arms department had been built around a job ticket. The number of hours of labor required for the production of each job, together with the payroll numbers of the men performing that labor, were recorded on the first, or summary, coupon, which was retained in the department superintendent's office. All that was required, therefore, to find the labor cost of producing any job was to apply the hourly pay rates of the men working on the jobs to the hours spent. The payroll clerk in the accounting office furnished the pin and coat-of-arms department clerk with a list of the men working in that department and their hourly rates. From this list and the job ticket summary it was a simple matter to compute the total labor expended on a job, and by dividing that total by the number of good finished pins in the lot the labor cost of each pin was quickly and easily ascertained. To facilitate this process two extra columns were added to the summary coupons of the job tickets. In one of these could be entered each man's hourly rate, and in the other could be entered the labor cost of performing each operation on the lot. Provision was made for totaling this last column.

9. COMPILING RAW MATERIALS COSTS

An equally simple means was devised for collecting the cost of raw materials used in the production of each lot of pins. The principal raw materials required were gold wire, gold strips, and small precious stones. These were all of small bulk and high unit value. They were stored in charge of one individual in the plant manager's office. There was practically no variation in the price of the gold used. Each lot of precious stones purchased was stored separately, and the purchase price of the lot was marked on the container. When the pin department superintendent ordered a given job into production, he wrote a requisition on the storeskeeper for all materials required. This requisition called for quantities by weight or number. The storeskeeper issued the requisitioned materials and used the requisition as part of the basis of his raw materials control. From the requisition and his own records of the raw materials purchase price, it was a simple matter for the storeskeeper to make up a brief bill of materials for each lot and send it to the office of the pin department superintendent. The clerk in that office entered the amount of raw materials and their cost on the back of the summary coupon for the job involved, and by dividing the total by the number of pins turned out in the lot obtained the materials cost of each pin produced. As a result of entering separately the cost of each material used for a lot, it was easy to get the materials cost for each operation involved if that information should be desired.

10. BURDEN COSTS

When direct labor and raw materials costs were found, there was but one other cost to be obtained, plant burden. As a usual thing burden cost is the most difficult of all costs to ascertain. It cannot be determined with absolute accuracy, and particularly is it difficult to collect the many items of which it is composed until long after raw materials and labor costs are known.

Burden includes a variety of unlike costs. Typical are machine maintenance, repair, depreciation, and power consumption. If the operation is carried on in leased property, rental costs are incurred. If the factory is owned, taxes, maintenance, and improvements replace rental charges. Whether company owned or not there will be plant housekeeping, heat and light, and security costs involved. There are many indirect labor costs to be included: supervision, paid holidays, worker insurance, health services, unemployment supplements, investment and retirement funds, and many others. Purchase price is not the only element in materials costs; storage expense, insurance, transport costs, deterioration, taxes, all add substantially to purchase price.

Some of these burden items are fixed in the sense that they do not vary with volume or rate of output; some increase or decrease with the production rate. Some change as the level of output changes but do not vary constantly and in direct proportion. Some burden costs are partly variable and partly fixed. Some vary under certain conditions of change but remain fixed under other conditions. To determine exactly the burden costs involved in the production of a unit of output or of a line of products is usually impossible. However, to the extent that executive or supervisory action can have an effect on the costs of such burden items, it is important that those responsible be kept informed of the results of their decisions. Thus effort is made to establish a reasonable degree of control over the items of indirect manufacturing expense; otherwise they can get out of hand and become unreasonably excessive.

In the interest of speed and economy it is customary to use standard rates for the calculation of burden costs by lots. The superintendent of the Belmont pin department in cooperation with the company accountant found from a study of the company's past records that most burden in the pin and coat-of-arms department normally tended to vary directly in proportion to the amount of direct labor employed. They found that the longer it took to process an order, the greater was the burden cost of its manufacture, and that the number of labor hours required for a job was a satisfactory index of the length of time required for processing. Their investigation further revealed that for each hour of direct labor employed, burden costs of $1.20 typically were incurred. Thus, to ascertain the burden cost of any job, it was only necessary to multiply the $1.20 hourly burden rate by the number of labor hours charged to the lot on the job ticket. After the standard hourly burden rate for the department had been determined, it was a simple matter to make the necessary calculation on the back of the summary coupon of each job ticket to arrive at the total standard burden cost of the job covered by the coupon. Dividing that total by the number of good pins in the lot gave the unit burden cost for each pin in that lot.

11. TYPES OF STANDARD BURDEN RATES

In their search for a means of ready determination of burden costs, the superintendent and accountant had considered several possibilities. Those upon which they finally centered their attention were a labor-hour rate (the one adopted), a percentage rate to be applied to the labor cost of the job, and a percentage rate to be applied to the prime costs of production, *i.e.*, to the sum of direct labor and raw materials costs. Investigation indicated that the hourly burden rate was the best of the three for that particular department.

The prime cost percentage was discarded because a study of pin design quickly showed that neither the amount nor the cost of raw materials going into a pin was an indication of the length of time required to make the pin. Time required to process seemed to be the best measure of burden involved and, therefore, the value of raw materials used would bear no relationship to burden. Prime cost could not well be used as a burden index.

The choice between labor hours and labor dollars was finally settled along similar lines. In some degree labor cost was a measure of time required to process. However, variation in existing wage rates and possible future fluctuation in wage rates of individual workers and of the group as a whole tended to make labor costs inaccurate as an index. Also occasional overtime in rush periods, which was paid for at 1½ times the regular rates, was a disturbing influence. The amount of labor time applied to each job was already known, and thus there seemed no practical difficulty in using that figure itself as a measure of burden cost. The burden rate of $1.20 per labor hour charged to the job seemed sufficiently accurate for purposes of departmental control and had besides the very necessary quality of ease of determination and calculation.

12. SUITABILITY OF STANDARD BURDEN RATES

The obvious lack of exactness in this procedure was not considered serious. In the first place the burden costs involved were in but very small measure under the control of the department superintendent, who, therefore, could not be held responsible for them. At the same time the superintendent could help to reduce burden costs by seeing to it that work passed through his department with expedition, and his accomplishments along that line would be reflected in the job costs if the labor-hour rate was used for burden purposes.

13. UNIT PRODUCT COSTS

By the simple methods here described, the unit cost of labor, raw materials, and burden could be quickly and easily calculated for any job turned out by the pin and coat-of-arms department. Addition of the three items would give the total cost of producing each pin.

14. USE OF THE COST DATA

In practice, the superintendent found it unnecessary to complete the computation for every job passing through his department. Hourly rates of all workers on every job were entered in the proper column provided on the summary coupon of the job ticket. Also raw materials costs were entered on the back of each summary coupon. Burden was applied and unit costs were figured only as called for by the superintendent. In controlling the work of his department, the superintendent found the availability of such data of great benefit. It helped him to judge the relative excellence of his workmen and of his foremen. The results of changes in methods of doing work were now measurable, and study of the cost records suggested many improvements which had hitherto been unsuspected. The designing department found the information helpful because it showed clearly the effect of different types of design on costs of production. The sales manager also found that he could use this cost information to advantage. While the work of the pin and coat-of-arms department was essentially for special order, analysis showed that almost all the jobs which came in either were basically like jobs that had been done in the past or were new combinations of operations with which the company had had experience. The cost data as compiled made it possible to forecast with great accuracy the probable cost of doing any job. For example, the pin described in the production control case[2] differed from one made the year before only in that another color of enamel was used and the engraved numeral was changed. Had the costs of producing the pin the year before been known in as much detail as the cost system here described provides, the cost of producing the new order could have been quite accurately predetermined. Such information was of great value to the sales manager in quoting prices on new work. If a customer objected to the price asked for a proposed job, the sales manager was in a position to suggest possible changes in materials or design which would bring the price of the pin within the limit which the customer could pay.

It should be emphasized, however, that, while the sales manager found the cost data valuable in quoting prices, the cost alone could not be made the basis of price setting. Competition of other producers made such a policy impossible. However, knowledge of costs did enable the sales department to quote prices much more intelligently and did make it possible for executives to foreknow within rather close limits what would be the effect on profits of taking business at the prices set.

15. SUMMARY AND CONCLUSIONS

Experience of the Belmont Jewelry Company. The president, department superintendent, designer, and sales manager of the Belmont Jewelry Company all found information on costs within the pin and coat-of-arms department of great value. The character of the data collected was such as to make them of maximum usefulness. The method of collection made the information quickly available and enabled the executives to correct errors before they had a serious effect on profits. The simplicity of the system made it very inexpensive in operation. The president of the company was very complimentary in his praise, and other department heads were urged to consider the possibility of collecting and using cost data.

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[2] See p. 504.

Cost Records as a Management Device. No attempt is being made in this volume to consider in detail methods of cost accounting. The importance of cost data as indicators of what should be done, as a yardstick of accomplishment, and as a means of fixing responsibility for results cannot be overlooked in any adequate introduction to the problem of managerial control. The student who proposes to make a career for himself in the field of production will, of course, go on to a thorough study of the methods and technique of cost accumulation.

Knowledge of current costs by types such as direct labor, materials used, supervision, maintenance, and the like can be very useful. A proper combination of selected cost items can help the manager to judge and improve the methods of performing individual production operations. Other combinations can help in controlling department and production center costs. The use of properly selected cost information as one help in judging the effectiveness with which individual supervisors and executives discharge their responsibilities is increasing. Thus understanding of the nature of a wide range of factory costs, of the methods of determination of such costs, of the proper uses of cost information is essential equipment for today's factory manager. Study in these areas is a must for the student executive-to-be.

It is important, however, that throughout any such study the student retain his management point of view. To be valuable in production control, a cost system should be simple. It should provide useful information and only useful information. This information should be in the form best suited to the particular ends and individuals served. The data which go to the foreman may well differ, as to both content and method of presentation, from the cost data provided the sales department. Consideration of matters such as the foregoing would often do much to transform costly, cumbersome, unusable cost systems, which are all too frequently regarded by production executives as statistical bone yards, into useful devices invaluable to management. In this day and age, business control that is not predicated on knowledge of costs is almost no control at all. On the other hand, an elaborate cost system all too frequently yields nothing except a feeling of self-righteousness on the part of a cost department plus an increase in the cost of production. The student of production management will gain much if he keeps this thought before him as he works his way through the intricacies of the techniques required for the essential tying in of cost accounts and management action.

QUESTIONS

1. What is a balance sheet? How can it be profitably used in business management?
2. How do two balance sheets of a business taken at different times tend to explain each other?
3. What is the profit and loss, or operating, statement? What is its relation to the balance sheets which immediately precede and follow it?
4. Why is the operating statement often found unsatisfactory for the purposes of the production executive?
5. What are the essential characteristics of cost information if such data are to be of maximum usefulness in the controlling of production processes?
6. What three kinds of cost information are collected? What are some of the items of cost included in each class?
7. How were labor costs by jobs and operations on each job collected in the pin and coat-of-arms department of the Belmont Jewelry Company?
8. How were raw materials costs for each job and operation obtained?
9. When the pin and coat-of-arms department of the Belmont Company used less material than initially was issued to it for the production of an order, the excess was returned to inventory. How would this be shown in the department's record of the cost of producing the order? Would showing this return or a supplementary issue if this were required be important? Why?
10. Describe the method of figuring burden costs for each job.
11. Why was it desirable to use a "standard rate" in calculating the burden cost?
12. Why was the number of labor hours applied to a job considered the best index of burden costs in this instance?
13. Under what conditions might a burden cost for each dollar of direct labor involved in an operation be a suitable index of actual burden applicable to the operation? Would you prefer to express such an index as a percentage or in dollars?
14. Sometimes the burden to be charged to a job is expressed as a dollar amount for each hour of machine operation (a "machine-hour rate"). Under what circumstances would such a method seem to be a suitable index?
15. How was the total cost per pin produced computed?

16. Who, within the Belmont Jewelry Company organization, found the use of the cost data valuable?

17. What use could each of these individuals make of the data?

18. If the cost data described were inaccurate, why was their use desirable?

19. How exact should cost data be?

20. What is the relation between a process control routine and a cost collection system?

21. Why did the clerk of the pin department not compute unit costs for every lot or job produced?

22. Why was each order made the basis of cost collection? Why did they not collect the costs of operating the department for a week or a month and then divide the total costs of the period by the number of pins produced during that period?

23. Wherein may failure to use costs in production control make for mistakes in management?

PROBLEM 57 ABLE BROTHERS, INC. (R)

> Able Brothers, Inc., reconditioned spinning rolls for a number of cotton mills located in a large New England textile city. Extensive improvements had been instituted in the standardization of equipment and tools, layout of machinery, routing of materials, introduction of incentive wage systems, and in the design and installation of an effective procedure for the control of production. As a further step the owner manager wished to secure cost information that would enable him to keep a check on operations in the several departments.

In processing cotton, the yarn passes between leather-covered rolls and fluted steel rolls. The covered rolls are approximately 8 inches in length and 1 inch in diameter (see Exhibit 1). Continued contact of the rolls ultimately destroys the leather surfacing and requires that the rolls be re-covered. An establishment offering such a service to a group of textile mills has an operating condition not unlike that of a laundry in that the property of the customer is brought to the plant at regularly recurring intervals for reconditioning. For example, at certain of the larger mills serviced by Able Brothers, Inc., rolls were called for on

Mondays, Wednesdays, and Fridays, the two-day intervals being sufficient to re-cover the rolls and to return them when another lot was collected. In other mills, deliveries and collections occurred once or twice a week. The mills maintained a small surplus of rolls which allowed them to arrange for re-covering without extended stoppage of machinery, since changes of rolls could be made after hours. Approximately 100,000 rolls were re-covered by Able Brothers, Inc., each week.

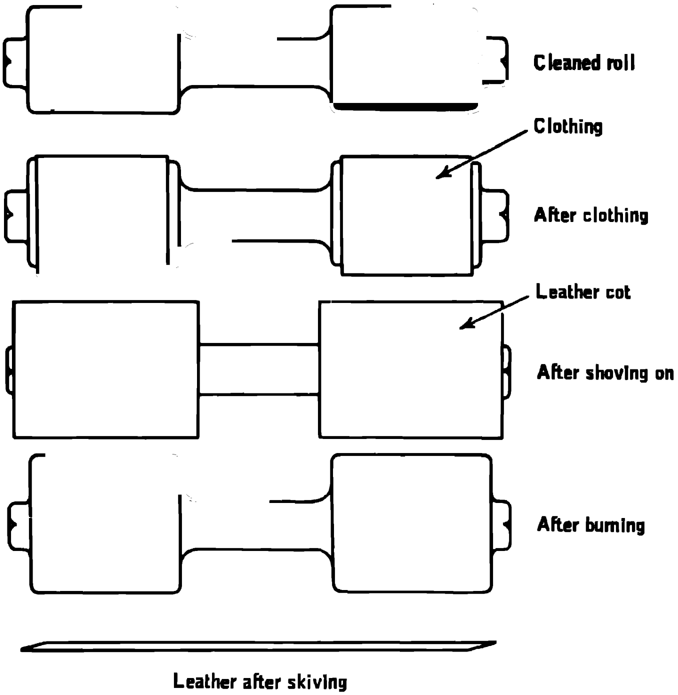

Exhibit 1. Able Brothers, Inc. Steps in the Process of Roll Covering.

DESCRIPTION OF THE PROCESS

The process of reconditioning was as follows:

Cleaning of Rolls (6 men). Rolls which had been collected from mills in mill boxes and delivered by truck to the washroom were placed in perforated steel baskets and dipped in a hot solvent which freed the rolls from felt and leather. The rolls were washed and removed by hand to a drying screen, after which they were tumbled in sawdust in a tumbling barrel. They were dumped upon a screen, replaced in mill boxes, and sent to the roll-covering department.[8]

Clothing of Rolls (10 men). Rolls were mounted on centers; each "boss" was spun against a glue brush and covered with felt.

Shoving-on of Rolls (5 men). Roll bosses were covered with cylindrical cots of leather.

Burning of Rolls (12 men). Rolls were mounted on high-speed spindle lathes and pressure was applied to the overhanging edges of the leather cots, causing them to burn and shrivel under the friction, locking the leather cot tightly to the roll.

Calendering of Rolls (2 men). Rolls were machine-polished between heated plates.

Calendering was the last operation, and rolls were then replaced in original mill boxes, invoiced, and delivered to the mills.

CLOTH PREPARATION

In the preparation of the cloth for assembly with the roll, two operations were necessary:

Stripping of Cloth (2 men). Large squares were cut from a roll of felt cloth and piled in layers of four or five thicknesses, after which they were cut into long strips of the required width.

Squaring of Cloth (no additional operatives). Strips were cut into pieces of such size that they would exactly surround the circumference of the iron roll.

LEATHER-COT PREPARATION

In the preparation of the leather for assembly with the clothed roll, several operations were necessary:

Stripping of Hides (2 men). Sheepskins were cut into strips of the required width.

Skiving of Strips (5 men). Strips were cut into rectangles of proper length to form tightly fitting cots. Strips were cut on a bevel (see Exhibit 1).

Cementing of Cots (20 women). Beveled edges were coated with glue and joined under pressure.

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[8] When received for the first time each roll was given a distinguishing mark similar to a laundry mark. This symbol was permanently stamped into the metal part of the roll. An office record was kept, showing all symbols and the firms the symbols represented. After a roll had once been re-covered, it was unnecessary again to stamp an identification symbol upon it.

Storage of Cots. Cots were placed in storage for 48 hours before using in order that the cement might set properly.

A general foreman had charge of all production, and each operation was in charge of a working boss who assigned work and supervised operations. As the number of types and sizes of rolls was small and as the customers were rather permanent, cloth squares and cots were made up for stock. Product in process was moved from one operation to another by the operatives, and an inspector approved all work performed after the clothing operation. Final inspection was performed by the calender machine operatives. All workers were paid by the hour.

Recently a time-study engineer had been retained to "improve methods and set performance standards." At the end of three months he had set the following standards:

Time per hundred rolls, clothing of rolls
Time per hundred rolls, shoving on of rolls
Time per hundred rolls, burning of rolls
Time per hundred rolls, calendering of rolls
Time per hundred hides, stripping of hides
Time per hundred cots, skiving of strips
Time per hundred cots, cementing of cots
Square feet of hides per thousand cots
Square feet of cloth per thousand cots

The time-study engineer also had made many suggestions for changes in workplace location and arrangement and for performance of operations. These recommendations had been put into effect before standards were set.

Maintenance of equipment was cared for by an outside contractor whose shop was in an adjacent building. The company employed one bookkeeper who also acted as secretary to the manager, the owner of the business. She had an assistant who did clerical work such as billing and assisting in preparation of the weekly payroll.

The owner of the business believed that it should be possible for him to keep better informed with respect to current operating efficiency and costs. With this in mind he asked the methods and time-study engineer to formulate a set of reports that would enable him to maintain closer control. He cautioned the engineer that because of the small size of the business and the narrowness of profit margin it was essential that any control method involve a minimum of expense.

If you had been the engineer what records would you suggest be kept to meet the owner's desires? What reports would you recommend

that the owner should receive? Who should make these reports, and how would the owner use them? Prepare forms for the reports you propose.

PROBLEM 58 BEARING MACHINE COMPANY (R)

The general manager of the Bearing Machine Company attended a metallurgical society meeting where a paper was delivered on the subject of powder metallurgy. The paper had stressed the advantages of this relatively new process as an alternate method of manufacturing many small accurate parts commonly turned out on screw machines. In the past the company's tachometer weights had been machined. The general manager, as a result of the talk on powder metallurgy, considered having the tachometer expander weights made by the powder-metallurgy process.

Bearing Machine Company designed and built specialized machinery for the soap, chemical, and textile industries. The company's tachometer, various models of which sold for $40 to $60, had been made as a side line for over 30 years for marine-engineering applications, diesel-electric locomotives, newspaper-printing machines, and textile machines.

The tachometer was based upon the centrifugal governor principle. Each governor employed three expander weights. Sales of the company's tachometer in recent years had increased steadily. In the previous year over 25,000 were sold.

Under the existing method of manufacturing expander weights, the company bought the blanks for the part from one of two screw-machine companies for $0.088 each, of which $0.02 was for bar stock and $0.068 for machining.

Bearing Machine Company performed the machining operations on the purchased blank to produce the finished expander weight. Standard times for the operations were as follows:

	Minutes
Milling (two operations)	0.64
Drilling two holes	0.16
Burring drilled holes	0.16

Milling operators received $1.60 per hour, while drilling and burring operators received $1.44 per hour. Overhead was computed as 100 per cent of direct labor and included all inspection costs on the expander weights. Of the expander weights machined, 5 per cent failed to meet inspection standards and had to be thrown away as scrap. Almost all spoilage was caused by faulty milling of the blanks. Fixtures used to hold the pieces when being milled cost $250 each, while the fixture used for the drilling operation cost $100. The life of all the fixtures was estimated at three years.

If the general manager decided to have the expander weights produced by the powder-metallurgy process, they could be bought from a company in the same city for $0.06 each plus an expenditure of $600 for dies. The dies would be guaranteed for 50,000 pieces. The expander weight was guaranteed to meet the required finished dimensions and would need only drilling and burring by the Bearing Machine Company. No milling would be necessary.

Should the general manager of the Bearing Machine Company purchase expander weights produced by the powdered-metallurgy process?

PROBLEM 59 HUB MOTOR CAR COMPANY (R)

John Bracken wished to buy a used automobile. After shopping around among used-car dealers, he found a three-year-old Studebaker at the Hub Motor Car Company that seemed to be what he wanted. A salesman demonstrated the car for him and said that the car was in first-class mechanical condition except that the overdrive with which it was equipped did not work. The price of the car was $1,040. The salesman said that he would have the overdrive replaced, but in that event the price would be $1,095; the additional $55 was the regular standard price for replacing an overdrive unit. Mr. Bracken was not interested in the overdrive. Although the salesman was willing to guarantee that Mr. Bracken would never have any trouble from the defective overdrive if it were left just as it was, Mr. Bracken decided that he did not wish to take that chance. He offered to buy the car for $1,040, provided that the Hub Motor Car Company would remove the overdrive unit completely.

The overdrive could be removed from the car readily. It would take a mechanic three hours to do the work; no new parts or materials would be required. The Hub company had a standard service charge of $5 per hour for all repair work. This covered all costs (except parts which were charged separately) and included a profit for the company. The $5 was based on cost records which the company had built up over a period of time and which the management was convinced were accurate. The Hub company paid its mechanics straight day wages, $16 for an eight-hour day. The men worked on repair jobs as they were assigned to them by the shop foreman.

When Mr. Bracken offered to buy the car, with the overdrive removed, for $1,040, the salesman went to the repair shop. He learned from the shop foreman that the standard charge for removing the unit would be $15. This included $6 for labor, $6 for burden and general administrative expense. He also was told that the foreman had three good mechanics in the shop who were doing nothing at the time. When work was slack, the foreman did not lay off his men temporarily. Good mechanics were hard to get, and there were times when the shop was so busy that the foreman wished he had several more mechanics than he had. The foreman would be glad to put a mechanic to work removing the overdrive unit at once. He did not like to have his men idle about the shop.

The salesman went to the sales manager and told him that Mr. Bracken would buy the Studebaker if the company would remove the overdrive. The sales manager refused to do this unless Mr. Bracken would pay an additional $15, the standard charge for the work. He pointed out that considering existing price levels $1,040 was a relatively low price for the car. The Hub Motor Car Company never cut prices on its cars and did not bargain on price with customers. The salesman told the sales manager of the situation in the repair shop, but the latter still refused the salesman's request, saying that he was unwilling to take less profit on the car than he would get from the sale of the car for $1,040 in its present condition. The salesman was unable to convince his superior that he should accept Mr. Bracken's offer.

Who was right, the salesman or the sales manager? Explain.

PROBLEM 60 SCARRELL COMPANY (R)

The wide variety of miscellaneous metal products manufactured by the Scarrell Company included a small patented part used in automobile assembly. This unit was a very profitable item. Company salesmen had persuaded several large automobile manufacturers to incorporate it in their products. Demand for this part expanded to a point where it was evident to the production executives of the Scarrell Company that promised deliveries could not be made on time unless approximately 25 per cent more crimping capacity was made available. After examining the possibilities in this direction, the engineering department recommended that the ratchet-dial assembly press used in crimping the two sections of this unit together should be fitted with a semiautomatic feed, which would increase its capacity by approximately two-thirds. This fixture could be made in a few days in the company's own machine shop at a total cost of $137.

The Scarrell Company sold these patented parts to automobile manufacturers on the basis of annual contracts under which purchasers agreed to buy within a year specified minimum numbers of units to be delivered as called for. The Scarrell Company agreed, on its part, to supply all its customers' requirements during the terms of the contracts. Although the purchasers attempted to give as much advance notice of their needs as possible, they occasionally asked for immediate delivery. Demand was markedly seasonal; as much as one-quarter of annual deliveries sometimes had been made in a single month.

Under the existing production methods, the operator of the ratchet-dial assembly press fed into the press by hand the two sections which were to be crimped. If the fixture recommended by the engineering department was installed, one part would be fed in automatically from a hopper; the other would still be fed in by hand. This would permit changing the pulley ratio, which would speed up the rotating crimping die, and would result in an increase in the standard hourly output of the press from 2,500 units an hour to 4,159 units an hour. The operator, who was paid on a piece-rate basis, would probably continue to exceed standard output by approximately 30 per cent after he became accustomed to the change in procedure.

The engineering department reported that, if the semiautomatic feed was installed, unit costs of the crimping operation would be reduced 40 per cent as follows:

	Cost of crimping operation per 1,000 units	
	Hand feed	Semiautomatic feed
Labor	$0.56	$0.336
Overhead (150 per cent of labor)	0.84	0.504
Total	$1.40	$0.84

The cost of the fixture, which could be made up without delay by the permanent staff of the company's machine shop, was estimated as follows:

Labor	$ 70
Materials	32
Overhead (50 per cent of labor)	35
Total	$137

The ratchet-dial assembly press assigned to the production of this small automobile part was currently being operated on a single-shift basis, although some of the company's equipment was being operated in two or even three shifts. The output of this press could therefore be increased by operating it in two shifts. Moreover, any one of several ratchet-dial assembly presses which were standing idle in the company's plant could be converted to the crimping of this part by expending $84 for dies. When thus converted, both sections of the part would be fed into the press by hand. If either of these alternative methods was adopted, the semiautomatic feed would not be required to meet deliveries.

QUESTIONS

1. Should the recommendations of the engineering department be carried out?

2. During the time this problem was under consideration, and before a decision had been reached, the company signed a new union contract. The new contract included a wage increase of 5 per cent for all workers. How, if at all, would this affect your decision on the crimping press problem?

23
BUDGETARY CONTROL

THE AMERICAN-CHAPMAN COMPANY

1. AN EXAMPLE OF MODERN METHODS OF BUDGETARY COST CONTROL

In 1961 the sales of the American-Chapman Company were just under one billion dollars. Its 19 plants produced a variety of products for home and industrial use. All its products were used in either the production or consumption of electric energy. In many of its product lines it was an active and successful competitor of much larger corporations such as the Westinghouse Electric and General Electric companies. Although its production and its management were decentralized, all operations were tightly controlled. Both local and central managements relied in large measure on information furnished them by budgetary systems which emphasized the need for prompt management action to meet fluctuations in volume of demand and output.

2. NATURE OF PRODUCTION COSTS

Production costs may be classified for purposes of executive control into three types: raw materials, direct labor, and burden. Burden, in turn, may be subdivided into such classifications as indirect labor, indirect materials and supplies, and fixed charges. Although burden in total commonly is affected less by changes in volume of production than are raw materials and direct labor costs, different items of burden cost are variously affected by changes in volume. For example, depreciation on equipment ordinarily bears little relation to volume, while wages of hourly paid subforemen often are as variable as direct labor; between these extremes are a wide variety of items, such as wages of production and cost clerks, power, maintenance, and supplies.

3. MANAGEMENT CONTROL OF COSTS

There are two common management attitudes toward control of production costs. First, there are those managers who believe that if production is carried on, costs are inevitable, and therefore careful practice of economy and efficiency during the production period will result in costs as low as possible under the circumstances. Results obtained can be determined more accurately upon the expiration of the operating period, when costs can be compiled and compared with income and profit or loss results ascertained. In many cases, this is the method and extent of control exercised by management over costs of production.

The other philosophy of cost control emphasizes the concept that in considerable degree costs will be what management makes them. Study of the nature of production costs shows that various items are affected differently by changes in production load. Study of individual items of production cost reveals that within certain ranges of volume the effect of volume change upon cost items is subject to managerial control. Case studies of management policy and activity demonstrate that many factors other than change in volume influence costs. Product design, line make-up, scheduling practices, and plant layout are such matters. One must conclude, therefore, that sound management dictates the desirability of accepting the philosophy that costs are what management makes them.

If costs are in considerable degree under the control of management, it becomes incumbent upon executives to preplan costs, to control operations in terms of plans, and to accept responsibility for variations of actual from forecast results. This conclusion is consistent with the concepts of modern management developed in Chap. 2. This responsibility has become rather universally recognized, and one procedure adopted to facilitate the discharge of the function is known as budgeting.

4. BUDGETING

Budgeting control embraces three main activities: planning of results, continuous comparison of actual with estimated figures, and executive action resulting from consideration and comparison of estimated and actual costs. Budgeting is widely applied, as in the following:

Manufacturing operations budgets
Raw materials budgets
Labor budgets
Indirect manufacturing expense or burden budgets
Equipment or plant investment budgets
Sales budgets
Financial budgets

Budgeting procedure usually starts with drawing up a sales budget, which gives the physical output expected. This is followed by a manufacturing budget made up of individual budgets for raw materials, labor, and expense. These estimates may be simple or complex, depending on conditions of operation, size of the business, nature of the business, and other factors.

Such budgets also may be static or variable. The former give a cross section of average expected results, while variable budgets make allowance for adjustment to variable volumes of production. The theory of the variable budget can be applied to any of the elements that go to make up costs.

Following is an example of a static weekly budget as applied to a department employing a superintendent, two salaried foremen, three subforemen, one methods man, ten service employees, two maintenance men, nine clerks, and three inspectors.

Raw materials (detailed)		$10,402
Direct labor:		
25 × $1.40 per hour × 40 hours	$1,400	
50 × $1.55 per hour × 40 hours	3,100	
30 × $1.75 per hour × 40 hours	2,100	
10 × $2.25 per hour × 40 hours	900	
Overtime, 4 hours	1,125	
Total direct labor		$ 8,625
Indirect labor:		
1 Superintendent	$ 200	
2 Salaried foremen	320	
3 Subforemen, 40 hours at $3.00 per hour	360	
3 Subforemen, 4 hours overtime	54	
1 Methods man, 40 hours	175	
10 Service employees, 40 hours at $1.40 per hour	560	
10 Service employees, 4 hours overtime	84	
2 Maintenance men, 40 hours at $2.50 per hour	200	
9 Clerks, 40 hours	630	
3 Inspectors, 40 hours	345	
3 Inspectors, 4 hours overtime	52	
Total indirect labor		$ 2,980
Miscellaneous shop materials		440
Power, heat, and light		871
Other operating expenses		1,323
Fixed charges: Depreciation, etc.		2,387
Total cost to manufacture		$27,028

These figures are set on the basis of expected volume and past experience as to costs, with consideration given to any anticipated changes. A quarterly or annual budget could be built up from a series of weekly budgets. If seasonal changes or other influences affect the expected rate of operation, it is necessary to adjust items in the weekly budget to take into account such influences.

A static budget of the type illustrated above is satisfactory only as long as the volume manufactured during the period covered by the budget remains in the vicinity of the estimate upon which the budget was calculated. If volume should increase or decrease materially, this measuring stick would not be adequate. This shortcoming is felt as soon as one attempts to prepare a quarterly or annual budget from the weekly figures, since a steady weekly load is uncommon in many departments, shops, or plants. The reason for inadequacy of the static budget as an operating goal is of course to be found in the nature of cost items and their characteristic reactions to volume changes.

5. EFFECT OF VOLUME CHANGE ON COST—THE PROFITGRAPH

From the standpoint of the effect of volume load on costs of manufacture, costs are often classified as fixed, or nonvariable, and variable, but realism necessitates a reclassification into fixed, variable, and partly variable or semivariable costs.

According to this classification, variable costs are those which vary directly and continuously as volume changes. Semivariable costs, on the other hand, are those which are influenced by changes in the volume of production but do not vary continuously as volume changes. In a department where piece rates prevail, increase in volume results in proportionate increase in direct labor costs. These costs go up or down in proportion as volume increases or decreases unless some change is made in piece rates or processing. As some of today's "fringe benefits" to direct labor (paid vacations, insurance, unemployment compensation, etc.) are more closely related to time—seniority or hours or days worked—than they are to earnings on piece rates, these components of direct labor cost often are treated as indirect manufacturing expense. As such, they do not appear as the direct labor costs which, in reality, they are.

Cost of departmental supervision does not fluctuate so automatically with output change. This item of cost is influenced by volume, however, although not continuously. If production increases to such a point that the department foreman is overloaded, he may be given an assistant. Should volume fall to a very low point, the foreman may spend most of his time at some direct labor job within the department, his compensation as foreman being reduced. It is seen, therefore, that departmental supervision is a cost which varies with changes in rate of operation but does not vary continuously. Changes in the item will be brought about as a result of management action, the amount of the changes, and the time of their becoming effective being under the control of management.

Adding or dropping a shift causes substantial changes in semi-variable costs. The result is illustrated in Exhibit 1. The time when

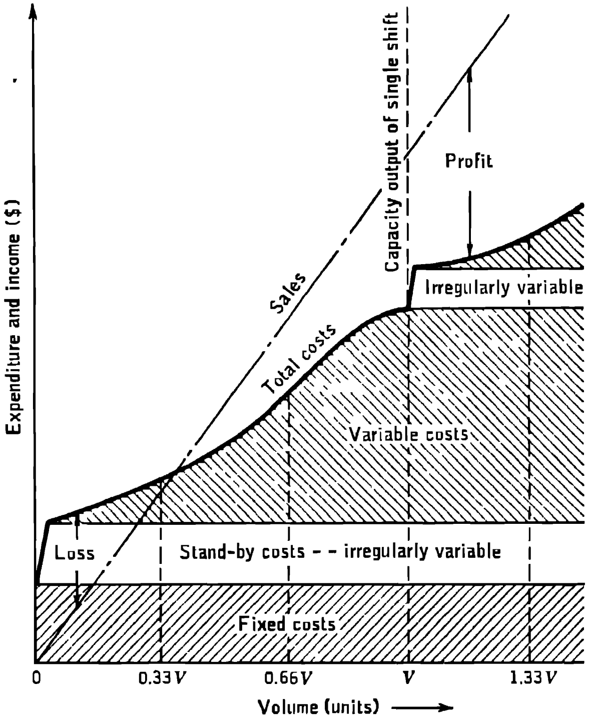

Exhibit 1. Cost Curve at Varying Volumes of Production. (V = Capacity output of a single shift.)

such a change is made will in large degree determine the form of the cost curve in relation to volume of output. Actually a cost curve at varying volumes of production is likely to assume the form shown in Exhibit 1. The sales line is added on the assumption that the volume sold equals the volume produced.

It should be noted in connection with Exhibit 1 that fixed costs are those costs which would still be experienced in the event of complete temporary shutdown. When the department or plant is put into operation, a jump in costs is experienced which bears little relation to initial volume of operation. It represents the difference in costs between shutdown and minimum operation. These costs are characterized as "stand-by costs." They are variable but in an irregular way.

It also should be noted that such sudden jumps in costs may be experienced at other points in the production scale. The jump experienced when volume is increased beyond single-shift capacity represents a new series of stand-by costs resulting from the additional shift. Items such as salaried foremen, found among the initial stand-by costs, are characteristic of the costs incurred when a second shift is added.

The character of the total curve between the points of 33 per cent and 100 per cent of one-shift operation is important. The regularity of increase within that range suggests the practical possibility of assuming that for normal volumes variation in costs tends to be directly proportionate to volume change.

Projection of the sales line graphically displays the important part which volume of operation plays in the making of profits or losses.

Obviously, budgetary estimates should be prepared so as to make possible anticipation of results at varying volumes and judgment of actual results at whatever volume is finally experienced. In other words, the variable budget recognizes the fallibility of sales estimates and makes control possible even though volume varies.

6. PRACTICE AND EXPERIENCE OF THE AMERICAN-CHAPMAN COMPANY

Management of the American-Chapman Company was decentralized. The general manager of each of the company's 19 plant divisions was responsible for all activities of the division: product development, sales, manufacturing, and current financing. Industrial relations, corporate financing, corporate accounting, and over-all corporate policy were centralized at the company's headquarters in Chicago. Several departments which provided all 19 divisions with certain technical services also were maintained at the home office. An example of such services rendered was the central "operations auditing" group. This unit had been established to develop standard budgetary control for the divisions. The group had developed procedures best suited to the particular operating conditions existing in each of the 19 plants. It had aided the divisions in installing budgetary control, had trained division personnel in the system procedures, and subsequently was available for advice and help to executives in effective use of the information provided by the system. All decisions and action based on budgetary information were the responsibility of the local management. The home office group's responsibility was limited to advisory service with respect to the budgetary system only.

At the plants, costs were controlled for each of the 193 operating departments separately. Each operating department was provided with a variable budget, *i.e.*, one prepared for varying volumes. Although all department budgets were similar in principle, they differed in detail to conform to the needs of each department. Products manufactured varied from heavy industrial apparatus such as electric substation transformers requiring several weeks to manufacture to household items such as toasters and small electric fans and clocks produced at the rate of hundreds daily. A department's budget was designed to suit the character of its products and the manufacturing process involved.

Departmental direct labor and materials costs were budgeted separately from departmental burden, indirect manufacturing expense (IME) as this latter class of costs was called. As the principles employed in budgeting all three types of costs were similar, and indirect manufacturing expense was the most difficult to control, methods and practices of IME control only will be discussed here.

Use of departmental budgets fixed responsibility and furnished a basis for rewarding accomplishment. Departmental budgets were periodically consolidated into works budgets for purposes of control by senior executives.

Exhibit 2, page 607, is an example of the form of analysis used in preparing the departmental IME budgets. Direct labor costs are given for three operating loads: one of 32 hours a week, one of 40 hours, and one of 44 hours. The 40-hour load is for a normal five-day, eight-hour, single-shift operation. The 32-hour load is obtained by working four eight-hour days. The 44-hour load is based on five eight-hour days plus a half day, four hours, on Saturday for which overtime must be paid to hourly-paid or piecework workers.

The 32-hour load (load 1) has a direct labor cost of $5,775; the direct labor cost of the 40-hour load (load 2) is $7,500, an increase of $1,725. The comparable increase in total nonproductive labor cost (from $2,270 to $2,790) is $520. By examining the individual items of indirect labor cost, we can see what caused this change. Three items of cost, the salaries of the superintendent, the two salaried foremen, and the methods man, remain unchanged. Within the range of load variation shown by loads 1 and 2 these costs remain constant; they are fixed. The cost items hourly subforemen, maintenance labor, and inspectors vary directly with and in proportion to the change in

Exhibit 2 American-Chapman Company

Details of Indirect Manufacturing Expenses of Department 168 for Three Conditions of Direct Labor Load

	No-load basis		32 hour load basis			40-hour load basis			44-hour load basis		
			Load 1			Load 2			Load 3		
	Actual at zero	Theoretical or mathematical at zero	Number of employees	Total hours	Take-home pay	Number of employees	Total hours	Take home pay	Number of employees	Total hours	Take home pay
Total productive operators	0	0	105	3 360	$5 775	115	4 600	$7 500	115	5 060	$8 62[illegible]
Indirect manufacturing expense											
Indirect labor											
Superintendent	$ 175	$ 200	1		$ 200	1		$ 200	1		$ 200
Salaried foremen		240	2		320	2		320	2		320
Hourly subforemen		48	3	96	288	3	120	360	3	132	360
Methods men			1	32	175	1	40	175	1	40	175
Service employees											
Helpers			5	160		5	200		5	220	
Stockkeepers	112		3	96	403	3	120	560	3	132	560
Others			1	32		2	80		2	88	
Maintenance men	100	25	2	64	160	2	80	200	2	80	200
Clerical											
Shop clerks			3	96		3	120		3	120	
Cost clerks	56		2	64	448	2	80	630	2	80	630
Other clerks			3	96		4	160		4	160	
Inspectors		45	3	96	276	3	120	345	3	120	345
Overtime											
Foremen—hourly									3	12	54
Others									13	52	136
Total indirect labor	$ 443	$ 558			$2 270			$2 790			$2 980
Materials and other expenses											
Miscellaneous shop materials	$ 51	$ 51			$ 295			$ 401			$ 440
Power, heat, and light	100	100			699			791			871
Other operating expense					1 013			1 266			1 323
Total indirect manufacturing expense (IME)	$ 594	$ 709			$4 277			$5 248			$5 614
Fixed charges	$2 252	$2 252			$2 304			$2 354			$2 387
Total manufacturing expense	$2 846	$2 961			$6 581			$7 602			$8 001
Per cent nonproductive labor to productive labor	Infinite	Infinite			40			37			34
Per cent IME to productive labor	Infinite	Infinite			75			70			65
Per cent total manufacturing expense to productive labor	Infinite	Infinite			115			101			93

hours of operation. Costs of service employees and clerks vary with the change in direct labor but not in direct proportion to it. An examination of the numbers of "clerical" employees shows that at the 32-hour load there is one less clerk on the payroll than there is at the 40-hour load. The pay of each clerk on the payroll does vary in proportion to the load change. When making comparisons, it should be noted that there are 10 fewer direct workers on the 32-hour load basis.

Materials and other expense items vary with the load but not in proportion to the change.

Thus analysis of the composition of this department's IME for the two load bases reveals three types of IME cost components: fixed costs, costs that vary directly with and in proportion to load change, and costs that increase or decrease as the load changes but not in proportion to it. Availability of this information facilitates the process of preparing a realistic budget forecast for an expected rate of operation.

Load 3, the 44-hour load basis, shows the usefulness of the foregoing analysis. As would be anticipated the three items of fixed cost remain unchanged in the load 3 calculation. The people involved are salaried employees, and the half-day shift on Saturday carries no additional compensation for them. The three subforemen are paid on an hourly basis, and their compensation increases with the addition of four hours on Saturday. These additional hours are overtime and as such are paid for at the rate of time and one-half. This is reflected in the $54 overtime pay to hourly foremen. The same is true of the service employees, maintenance men, and shop clerks. Because the additional four hours is overtime, the increase in these costs is not in direct proportion to the load increase. If the four-hour increase had been from a 36-hour load to a 40-hour load, no overtime would have been involved, and the cost increase would have been proportional to the load increase. From this it is clear that budget make-up cannot be a purely automatic or mathematical procedure. Classification of the individual expense items is helpful, but individual consideration of the impact of any proposed load change is essential.

Consideration of the costs of maintaining this department on a stand-by basis further emphasizes this requirement. The theoretical or mathematical at zero of the no-load basis is straight projection of costs from the 32-hour and 40-hour figures. The superintendent and salaried foremen are shown as fixed. Because the department is not operating the methods man has been laid off, and no cost is included.

The $48 hourly subforemen cost is a straight-line projection based on the concept that this item varies directly in proportion to the load. A similar projection for the maintenance men item brings this cost to $25 at zero load (stand-by). Straight-line projections for the directly variable service employees and clerical costs bring these items below the zero amount. The $45 inspection cost is a straight projection. This is a theoretical picture of the costs shown in Exhibit 1 as stand-by costs.

The forecast of actual stand-by cost at zero operating load is shown in the actual at zero column under no-load basis. Under these conditions it is expected that the department will be manned by five people, all on a 40-hour work schedule. The superintendent's salary has been cut to $175 per week. Two service employees are retained, probably for "housekeeping" work within the department. There is a full-time maintenance man; the shutdown probably presents an excellent opportunity for needed maintenance work that is not easy to do when the department is in operation. One full-time clerk is required to maintain the records changes that are needed. Thus an IME budget of $594 is considered to be more realistic under stand-by conditions than is the $709 theoretical projection figure. It should be noted that some of the realistic figures are less than those of the projection and that some of them are higher.

The no-load stand-by budget and the 44-hour load budget both make good use of information obtained from the 32-hour and 40-hour load figures. In neither case are these latter figures adequate. They must be modified to conform to conditions and realities. Variable budgeting is not a purely mathematical or automatic process.

7. HOW THE DEPARTMENTAL BUDGETS WERE USED

Weekly budgets for each American-Chapman Company department were prepared in the manner just described for Department 168. Whenever possible the department head was provided with weekly budgets for at least four weeks in advance. Conformance with the budget expectations required that the department heads take action, and often the required action necessitated advanced information. Each week the department superintendent was provided with a budget forecast covering each of the forthcoming four weeks. Each weekly forecast contained information such as that shown for the Department 168 40-hour load. Beside each of these four weekly columns was a column headed "Revisions." Whenever a current weekly forecast differed from that previously issued to the supervisor for that week, the change was noted in the revisions column. In this way the budgets were kept current.

In addition to the eight forecast columns, the weekly budget had a column which showed the details of the budget for the week just past. Beside it were two additional columns; one showed the actual costs of each IME item and the other any variation of actual cost from the budgeted cost. In this way supervisors responsible for department results were promptly informed of the outcome of their work and decisions of the past week and were in position to plan and take action based on current knowledge of results. This was planning and auditing (as described in Chap. 2) at the first-line operating level.

Indirect manufacturing expense is the most difficult type of operating cost to control effectively. During the past decade this cost has grown in importance steadily. There is evidence that this growth will continue. Effective control of the costs that make up IME can be had only at the first-line operating level. American-Chapman's IME budgetary procedure was an effort to get such control.

8. CONTROL AT THE FACTORY MANAGER LEVEL

Every fourth week the factory manager received consolidations of each department's weekly IME budgets. Detailed information was provided under six headings:

Current four weeks, forecast
Current four weeks, actual
Per cent realization, current four weeks
Budget forecast, year to date
Actual, year to date
Per cent realization, year to date

These reports furnished the means of keeping the factory manager constantly informed of current conditions in all departments in the plant. They indicated the effectiveness of management at the department level. They also indicated trends. These department reports were the basis of over-all plant budgeting. Together with direct labor and materials controls, the IME reports provided one base for top management's planning and control of division profits.

9. SUMMARY AND CONCLUSIONS

The Variable Budget as a Cost Control Device. In considerable degree, costs are subject to managerial control. The extent to which management may currently influence costs depends in large measure on the nature of the cost items. Considered from this point of view, so-called fixed costs can usually be influenced both directly and indirectly by operating executives. Many items of expense which usually are considered as fixed can be altered to some extent if perceived in time to permit modifying action to be taken. While this is not true of all fixed costs, it is possible more often than commonly is recognized. The variable budget, as a means of identifying and forecasting the impact of volume changes, helps management substantially to influence directly costs which otherwise do not respond to changes in business activity. The impetus to indirect influence of fixed costs is equally important. Measures often can be taken to improve sales volume when conditions indicate demand decline. The more explicit the impact of decline on fixed costs, the more likely is the executive to initiate action designed to reduce or even eliminate the foreseen reduction in operating load. Budgetary procedures can have this effect.

The operating executive's control over variable costs is frequently limited to indirect influences much as in the case of fixed costs. When piece rates are paid for labor, the unit labor cost does not change substantially, the total cost practically automatically going up or down as volume increases or decreases. The production supervisor has greater opportunity to influence these costs indirectly than he does in the case of fixed costs. He may devise better methods of doing the work. As volume increases, he may be able to subdivide the work so as to keep operatives more continuously on one job, thereby making job changes that justify lower piece rates. He may improve the workability of the materials with somewhat the same result. If time wages are paid, his opportunities and consequently his responsibility for labor productivity are even greater than is the case if piece rates are paid. Management control of other variable costs follows lines rather similar to the situation in the case of direct labor.

Semivariable costs probably call for the exercise of even greater judgment than do typically variable or nonvariable costs. Control of semivariable costs must be effectively timed in terms of output volume and volume change. The decision as to when changes in such costs should be brought about often requires far more discernment and judgment than does a decision as to the advisability of adding more direct workers, for example. To realize that a foreman has become overloaded or to judge the time when a foreman should be converted into a working boss requires a fine sense of management values and a perception of the results of change. Volume of output will exert some measure of control over semivariable costs, but not nearly so much as it does in the case of directly variable costs. The measure of good supervision is in great degree the extent to which the *supervisor* controls the elements of operation which are responsible for these irregularly variable costs.

Budgets can be a great help to the executive who seeks to control these costs for which he is responsible. Such budgets will be valuable to the extent that they are so planned as to conform to actual conditions and are then used as a means of measuring results and taking action. To this end it is obvious that budgetary procedure must reflect the differences in reaction of various costs to changes in rate of operation. The variable budget seems to be a means well suited to this purpose. The variable budget recognizes the fallibility of sales forecasts. It can be arranged to provide a yardstick for cost measurement regardless of normal volume variation. It can be made to emphasize the differences in effects of volume on variable, semivariable, and fixed costs. A budget which does these things can be most helpful to an executive who understands the purposes and use of budgets in control of costs.

Experience of the American-Chapman Company. Such has been the experience of the American-Chapman Company in the development and utilization of expense control. In the words of an executive of that company, "Expense is only the measure of a supervisor's ability in rendering service: in obtaining quantity and quality production and keeping promises. Successful expense control involves three fundamentals: sound conception, simplicity, and reduction of lags." These principles form the basis of the variable budget procedure of the American-Chapman Company.

Sound Conception. In the American-Chapman Company, expense control costs are meticulously preplanned, "blueprinted," for every normal circumstance under which these costs will be experienced. The detailed operating department setup described exemplifies this principle.

Simplicity. Paragraph 7 of this chapter shows the clarity and lack of complication of the departmental budget. The reports show details for the department and the character of every item and the amount which it should be under given circumstances. Actual results are set forth simply side by side with the yardstick against which they are measured, and the results of such measurement, the degree of the supervisor's accomplishment, are clear. Whenever results depart substantially from the blueprint, reasons must be given for such failure by the executive responsible, in this case the department supervisor. Throughout the complete control procedure, and particularly at all points of contact with personnel, simplicity in the interest of clarity is the keynote. The use of direct labor hours as a measurement of load is an example of this. There are undoubtedly instances in so huge and diverse an organization in which some other volume index would seem preferable. However, through adherence to the one basis of measurement, simplicity is fostered in at least two ways. Use of direct labor hours as an index of load is universally understandable and provides a simple basis for consolidating departmental budgets into larger units and makes possible departmental and plant comparisons. Probably no characteristic is more essential to success in expense control than simplicity in conception and form.

Reduction of Lags. The necessity of eliminating time lags in securing actual figures is self-evident. The extent to which this has been done in the American-Chapman Company plan is in large measure responsible for the cost reductions that have been accomplished. First, it is important to note that the departmental budgets are weekly budgets. Then, much attention has been given the problem of making the reports which show degree of realization of the budget promptly available to departmental supervisors. In this way accomplishment and failure are quickly known and brought to the attention of the individual responsible. For example, failures to take action on semivariable costs at the times indicated by load area changes such as are shown in Exhibit 2 for service employees become quickly known and can be rectified before they seriously affect expense totals. Likewise, display of exceptional judgment and foresight in the control of such costs instantly shows up in terms of dollars and cents. It has long been recognized that all too frequently cost accounting systems have failed to bring about the expected results because of a time lag between the performance and availability of knowledge of performance. The importance of preventing such time lag is even more essential to successful control of expense by means of the variable budget.

Effectiveness of the Variable Expense Budget. Given sound conception, simplicity, and elimination of lag, education of the executive force in cost control will produce highly satisfactory results. These results will evidence themselves in departmental cost figures. Even more graphically are they seen if their effect on the total cost line in Exhibit 1 is studied. It has been the experience of the American-Chapman Company that expense control not only has lowered this curve throughout its entirety but it has also effected a substantial straightening of the curve. This result is, of course, of great importance, and at first thought might seem surprising. When one considers, however, certain aspects of variable budget control, the inevitableness of such an outcome becomes more apparent. In the first place, the budgeting of costs in advance of their incurrence naturally focuses attention on undesirable highs. Such spotlighting makes possible remedial action. Thus irregularities tend to disappear, total costs rise and fall more uniformly with volume fluctuation, and unit costs become more stable. As the curve straightens, the angle of slope will naturally become the focus of executive attention, particularly in relation to its point of reading on the expenditures scale at minimum operating volume. In this latter matter, American-Chapman Company executives have found it possible to accomplish much. It is interesting to note that in the manufacture of certain lines of product it has become possible to pass from one-shift to two-shift operation, or the reverse, with almost no jump in the total cost curve at the point of change.

Future Importance of IME Control. There is every reason to expect that indirect manufacturing expense will continue to grow in importance. Rapid increase in mechanization of manufacturing operations, automation, electronic data processing, new products of greater design complexity, increased frequency of new product introduction, all tend to increase various items of manufacturing expense. Although some managements view such increase with alarm, there is no basic need to do so. As technology develops it is inevitable that there will be shifts in the relative importance of the various types of cost that make up the total cost structure. If management assures itself of adequate procedures for cost control, the relative increase or decrease of cost elements need be no serious matter in itself. The characteristic trend to increased indirect costs does emphatically call for thorough control of this class of costs. The experience of the American-Chapman Company, like many other well-managed enterprises, shows clearly that such control is possible. Effective control of indirect manufacturing costs simply calls for effective exercise of normal managing functions: planning, activating of plans, auditing of results, replanning, reactivating, and constant remeasurement.

In too many businesses the potentialities of cost control seem hardly to have been tapped. This must change if many of these businesses are to survive tomorrow's competition. The manufacturing operations of the American-Chapman Company are carried on in many plants. Some of these are very large, some are small, and the products turned out vary tremendously. If a uniform approach for cost control can be worked out to apply successfully to this diverse group, it would seem that in the average, less complicated business the possibility of getting comparable results would be great.

QUESTIONS

1. What major types of costs comprise the total cost structure of a manufacturing business? Which of these are manufacturing costs?

2. Into what three large groups are these costs of production usually classified? Name typical items of cost that are commonly found in each classification.

3. Explain a useful classification of the cost items that make up "burden."

4. From your experience with the American-Chapman Company case classify the following cost items as being directly variable, semi-variable, and fixed and explain why you classify each as you do:

Office and shop supplies
Hourly wages of cost clerks
Hourly paid inspectors
Departmental telephone and telegraph expenses
Overtime premiums
Salaried supervisors and foremen
Hourly paid maintenance workers
Night shift bonuses
Salaried methods engineers
Depreciation of machines
Sweepers
Machine oilers
Water used in processing
Greases and oils used on machines
Heat, light, and power
Scheduling clerks, hourly
Chief clerk, salaried
Materials and work-in-process handlers
Tool crib attendant
Vacation pay
Local property taxes on equipment

5. What is the significance to management of the Profitgraph shown on page 604?

6. Explain the usefulness to the management of Department 168 of the data shown in Exhibit 2, page 607.

7. What use would the superintendent of Department 168 make of the weekly budget information which was furnished him? How does this information make it easier for him to meet the requirements of his responsibilities?

8. How will the IME departmental budgets be used by the factory manager?

9. Explain the significance of "sound conception, simplicity, and reduction of lags" as characteristics of effective budgetary control for operating purposes.

10. Why must IME budgets be based on sales forecasts?

11. How does automation increase the importance of IME control?

12. How can electronic data processing aid in making IME control effective?

PROBLEM 61 AMERICAN-CHAPMAN COMPANY (B)

1. Department 168, in common with other departments of the plant, operated under the variable budget system. For several weeks it had been operating with a direct labor load of $7,500 per week. The detailed expense budget of Department 168 at that rate of operation is shown in Exhibit 2 of the (A) case. The department superintendent had been notified that characteristic seasonal dullness would necessitate some curtailment of operations in Department 168 and that the direct labor load for the ensuing week would be $6,500.

Using the data shown in Exhibit 2, page 607, prepare an expense budget for Department 168 for a direct labor load of $6,500.

2. In the American-Chapman Company budgetary program, responsibility for getting the results outlined in the budget was placed squarely upon the supervisor in charge of the department. Department 168 had been operating for some time at a load level of $7,500 direct labor cost. In anticipation of seasonal dullness, the rate of operation of Department 168 was to be reduced to a direct labor load of $6,500 with the expectation that the department would operate at or around that rate for six to eight weeks, after which activity was expected to increase gradually.

Assume that you are the department supervisor and that you have been notified to put your department on a $6,500 direct labor load the following week and have been furnished with the department budget for that figure. Using the budget you worked out in question 1, prepare a statement outlining in detail whatever action you believe should be taken to meet the budget requirement of Department 168.

PROBLEM 62 UNITED STATES RADIO AND TELEVISION CORPORATION

The United States Radio and Television Corporation made radio and television sets in a variety of models. When operating at normal capacity, it employed about 1,200 workers. Inasmuch as the chief risk of the business was sudden changes in design to include technical improvements or style changes, close control of inventory of parts and finished products was especially important. Shortly before a recent sharp decline in radio sales, the company had adopted a plan of sales forecasting and budgetary control based chiefly on the use of standard costs. These forecasts had been so successful that when the decline came the company had practically cleared its inventory.

Practically all the planning and budgeting work of the United States Radio and Television Corporation was based on the determination and use of "standard" production costs. In most instances, the company was able to make use of already existing records. The standard costs, divided into direct labor, raw materials, and other costs, were collected for each model produced and for each factory department. Standard direct labor costs were based on engineering time studies of actual operations. Direct workers were paid on a group bonus plan, their pay depending on the number of completed parts or sets that passed inspection. They were paid an hourly rate plus a bonus of 100 per cent of any saving above the standard time allowance. Group foremen shared in the bonus, but general foremen and inspectors were paid day rates. The direct labor cost for each model remained constant except when a group failed to earn the bonus, which was unusual, or when the rate of hiring employees was changed and resulted in a change in the proficiency of the employees.

Standard materials costs for each model were figured when a model was put into production by pricing necessary quantities including waste allowance at a standard amount.

Standard costs for other departmental expenses were estimated carefully by the factory superintendent and foremen. They took into consideration the number of helpers required and the proper allowance for department supplies, power, and other expenses, including an allocated share of the costs of nonproductive departments. Each foreman signed the expense itemization he accepted as satisfactory and that was taken as the standard for his department. All expenses were divided into two groups: those which were fixed regardless of volume of production and those which were proportional to production and controllable. A summary expense sheet showing the total of the estimates of itemized departmental expenses gave directly the cost of doing any given volume of business. Profits were calculated at about the same percentage of price on all models.

After the current standards were set up, the next step in budgeting was to make a sales forecast. The sales manager drew up a preliminary estimate of sales by models and prices based on the trend of sales during the previous two years, corrected for changes in business conditions and prices and for stocks in dealers' hands. The sales manager submitted his preliminary estimate to the president, comptroller, and factory manager, who reviewed it in the light of their knowledge of market conditions, customers' requirements, and the standard costs. Recognizing the need for first-hand knowledge of current conditions, executives kept informed of the state of the industry and made frequent calls on the company's wholesalers, who numbered more than 100. In addition they received reports of dealers' stocks twice a month. Use of the standard cost data enabled executives to tell whether the estimated sales could be produced profitably for the price assumed by the sales manager and to see the effects of a higher price and smaller volume compared with a larger volume and lower price. Discussion of the advantages of the various alternatives led to a final forecast of sales and production requirements. The company was so successful in determining the standard costs and forecasting sales that actual sales were normally within 2 or 3 per cent of the forecast, and expenses were even nearer.

Using the figures for estimated production and standard costs, executives computed costs of operation and made out both an annual budget as a basis for general plans and commitments and a monthly budget as authorization for detailed manufacturing and purchasing schedules and for borrowing money. The budget for each period was practically an estimated profit and loss statement supported by detailed estimates by departments. From this statement could be computed balance sheets showing the position of each asset and liability account at any time. Additional financial and operating reports were compiled monthly. Estimates of the company's cash position did not vary more than 3 per cent from actual.

For controlling current operations, use of the standard costs was effective. Frequent reports of actual operations compared with the standard costs provided accurate bases for taking prompt remedial measures when actual costs were too high. Daily reports of variations from standard labor costs were made to foremen, and similar reports for all departments were made to the production executives. Daily reports also were made to company executives showing sales, orders, collections, disbursements, commitments, labor force, and production volume. More comprehensive analyses of profit variations were reported monthly.

The standard costs were used for purposes of cost accounting, and variations of actual from standard were cleared periodically through variation accounts into the profit and loss account. From analyses of the variation accounts, reports were compiled showing the causes of the variations, whether a price change, spoiled work, or something else.

The separation of fixed and controllable expenses also had been of good practical value. The company had been operating two factories, but analysis of expenses by the new method had brought to light an enormous fixed expense that had been concealed in general overhead. As a result, one plant was closed, and the office and supervisory staffs were consolidated. Fixed expense was reduced by nearly one-half.

Executives also made use of standard costs in determining general policies. Finding the most economical size of inventory of finished sets to carry was an example. Available records showed to what extent telegraph and express charges, unallocated and idle production time, and delays in filling orders would increase expenses as inventory decreased and how obsolescence, interest charges, and other carrying charges increased as inventory increased. With this information, executives decided on the optimum size of inventory.

Expense analysis was also useful to executives in deciding whether to accept new business. They considered not only the permanence of the new demand, but also the effects on individual and total costs of changes in the volume of operations for the plant or the effect of model changes on a departmental budget. They could tell, furthermore, how far they could cut prices without operating at a loss.

The executives were convinced of the value of the budgetary system and had found it inexpensive to operate. One clerk kept the books and made out the reports. An elaborate supply of forms had not been necessary, and many reports had been run off on duplicating machines.

Reports not required for record were destroyed, and those not used were discontinued. The plan provided executives with a basis for forming general policies, fitting production to sales, and measuring actual results of operations by focusing their attention on variations from standard. Average inventory turnover after the adoption of the control policy was 11.8 times a year.

QUESTIONS

1. What are the strengths and weaknesses of the budgetary program of the United States Radio and Television?

2. In your opinion is this procedure adequate to the needs of this company? What changes, if any, would you recommend?

3. This company made no sales forecasts until it had worked out cost estimates. When, if at all, is this good procedure?

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ORGANIZATION

THE ATLANTIC-UNION COMPANY (B)

1. A RAPIDLY GROWING COMPANY FINDS IT NECESSARY TO RECONSTRUCT ITS MANAGEMENT ORGANIZATION

The rapid growth of the Atlantic-Union Company had been such that in 1955 discussions of the president, the vice-presidents, and the executive committee of the board of directors resulted in the conclusion that the company's organization structure no longer was capable of coping with the many policy and operating problems faced throughout the company. The board then directed the president to undertake whatever organizational changes were necessary to revitalize executive action. During the next five years a program of management decentralization was put into effect. By 1961 top echelons had been restructured with gratifying results.

2. THE PERVASIVENESS OF ORGANIZATION

Wherever we find people working together we see organization. sometimes effective, too often ineffective. Ours is an "organized society." In sports and recreation, in religious activities, in community activities and drives, in education, in scientific endeavor, in medicine, in government and politics we depend on organization to reach our goals.

Organization is arranging the work and relationships of individuals in a group of people who together are undertaking the accomplishment of a common purpose. When the size of a task exceeds the capacity of one person, accomplishment of the objectives of the activity requires that the work be divided among the two or more people who are jointly responsible for results. That organization is an application of the specialization concept was explained in Chap. 5. Our purpose now is to explore this principle in greater depth, to learn how we can gain the benefits of specializing at the administrative level in ways such that we thereby assure attainment of common task objectives.

3. WHAT ORGANIZATION INVOLVES

The need for management organization in a manufacturing business occurs when one individual is unable to discharge all the varied responsibilities of the enterprise. When two or more executives share these responsibilities, the scope of activity of each must be clearly delineated to prevent duplication of effort and to make certain that every problem that arises receives prompt attention. It is the purpose of organization to define the activities of each executive and to coordinate their individual efforts. Thus, we find that organization essentially includes three concepts: division of responsibility for problem solution among the executives of a company, delegation of authority to take such action as is necessary to make decisions effective, coordination of the activities of individual executives in terms of company aims and policies.

The most common basis of division of the management field is in terms of major business functions: production, marketing, and finance. If the volume of business permits, there will be one executive in charge of each of these divisions: a production manager, a sales manager, and a secretary-treasurer. To make sure that the activities of each functional specialist are in harmony with the activities of the others, there must be a correlating force. This is usually embodied in the job of the general manager, who may or may not be the president or one of the functional executives.

When the work of management is subdivided, fixing of responsibility and delegation of authority go hand in hand. In preceding chapters it has been pointed out that a requisite to successful control of costs is management action based on a comparison of plans and results. A company which utilizes a budget must depend on a number of executives, including departmental supervisors or foremen, to take the requisite action. Each supervisor is held responsible for certain costs in his department and for doing things which will keep those costs in line with plans. No foreman can operate successfully under such a system unless three conditions exist. (1) He must be charged only with those costs over which he has some control—in terms of organization, the area of his responsibility must be clearly and properly defined. (2) He must have the right to take such action as is necessary to control his costs—again, in terms of organization, his authority to act must be commensurate with his responsibility for results. (3) He must take action that will be compatible with company policy—in terms of organization, he must correlate his acts with those of others functioning in the organization.

Business policy makes it possible to predict what type of action any executive within the organization will take under a given set of circumstances. Policy is a practical means employed to obtain coordination of the action of the various individuals that make up a business executive staff. It has been pointed out in the preceding chapter that, with reference to budgetary control methods, department foremen must take only such action as is compatible with company policy. If the foreman has been informed through budget channels that the operations of his department are to be contracted for a time, it is necessary for him to reduce the number of man-hours worked in his department. One way to do this would be to lay off some men. Another would be to retain all workers and reduce the number of hours each works. In deciding which method to employ, the foreman will be guided by his knowledge of company policy. His superiors will be assured of the type of action he will take under the circumstances because they will know that he understands company policy in this matter and will act in accordance with it. Thus, in event of general curtailment of operations, to a considerable extent all departmental supervisors will meet the problem in the same way. Friction and labor trouble will not arise as the result of one foreman's laying off men while others spread the available work among all workers in their departments.

4. THE DYNAMIC NATURE OF ORGANIZATION

Organization should be a result, the solution of the problem how to manage, rather than an aim. Organization should exist solely to serve a business. When business operation calls for a certain executive organization, it should be set up, never before. No organization should exist merely because it is a "sound form of organization." The only excuse for any particular form of organization is that it best serves the particular conditions that called it into being.

If organization is the result of a business demand, it follows that, as the need for organization changes, the organization should change. This is basic. One fundamental test of good organization is its ability to change, to adapt itself to new conditions. Many organizations can do this; some cannot. An organization which finds change difficult is usually an agglomeration of vested interests, bureaucracies. The business they control exists to serve their individual ends, not they to develop the business as a whole. The trouble with the inflexible business organization is that it is usually out of step with the profit-making possibilities of the business world as they exist at any one time. The less the need for organization, the better from the standpoint of ease of executive control. The less organization required to meet the need adequately, the better from the standpoint of the exercise of executive control.

5. THE PROCESS OF DEVELOPING ORGANIZATION

Assuming the foregoing as common characteristics, purposes, and goals of organization, let us next consider the process of organizing as one of the common activities of managing. The act of successful organizing is a four-step process. It necessitates the careful, explicit delineation of the whole task to be accomplished. This is followed by a breakdown of the total task into areas of activity whose nature and scope make them practical of accomplishment. Once this is done it becomes possible to write job descriptions, sometimes called position guides, that make explicit the responsibilities and authority of each position resulting from the breakdown. It is equally important that these descriptions cover fully the relationship of the described position to all other positions (or individuals) to which the position is operationally related. Only after these three steps have been taken should the selection of individuals to be placed in the various positions of responsibility be undertaken. Only by methodically carrying through this four-step process can an organizer have reasonable assurance that he has worked his way through to an effective organizational structure appropriately manned. Unfortunately, all too many short cuts are attempted, or necessities overlooked, in this process of organizing effectively. As we will see in our detailed consideration of the components of the organizing process, there inevitably are times when the organizer must compromise with what he knows (or should know) is good practice. But the closer the practitioner can adhere to the approach here described, the less will be the risks of unsatisfactory, even disastrous results.

6. DETERMINING AND DEFINING THE FULL SCOPE OF THE TASK

To say that before one can effectively carve up a melon into appropriate portions one must know the size and character of the melon seems platitudinous. However, all too frequently an executive will start carving before the full scope of that which is to be segmented is explicitly formulated. To say that the scope of a task is to "maximize profits" for the business or "achieve and maintain a dominant position" in the electronics industry in no sense defines explicitly the scope of a task. Whether or not the profits of a business are "maximized" at any point in time clearly is a matter of opinion. Further, the phrase "maximum profit" can have a variety of meanings. Does it refer to profit per dollar of product sold, to profit per dollar of stockholders' equity in the business, to profit per dollar of assets involved, or perhaps it just refers to the gross dollars earned without respect to any specific reference, either long or short run. To say that the total task is to maximize profits of the business is no adequate definition of a job to be done, the totality of the task to be accomplished.

To say that the job is to make the X Company the dominant factor in the electronics industry is equally ambiguous, inadequate. Just what is the "electronics industry." Only yesterday it was television and radar. Today it is computers, space communication, rocket control systems. There are those who believe that in the future this industry will be concerned with the worker-less, fully automatic factory; others suggest that it will be concerned with the replacement of human judgment in matters of international relationships. What is meant by "dominant"? Does this mean the leader in research and new product development, or does it mean the number one company in terms of dollar value of output? Perhaps it means the company in this undefined industry whose shares of stock are most widely held by the investing public.

No explicit task can be defined in terms of such "admirable" generalities. The number one step of defining the scope of an undertaking, a common task to be accomplished jointly by a group of business executives, must be definite in its statement of boundaries quantitatively and in units of time. But all too frequently the attitude is simply "who knows what the future really holds; generalities are the best we can foresee." Such intellectual lassitude is totally inadequate for the purposes of the organizer. We can do much better. Mr. Ralph Cordiner, chairman of the board of the General Electric Company, has been quoted as saying that the full soundness or weakness of many of the decisions he makes will not be known within his lifetime. But this does not deter him from making decisions based on the probabilities determinable in the situation.

7. SUBDIVIDING THE TOTAL TASK

When careful delineation of the total task shows it to be beyond the work (or skill) capacity of a single person, the process of subdivision is undertaken. Here the objective is to create tasks such that of each it is believed that a man (with appropriate assistance) can "get his arms around it." To assure this, a wide variety of influences must be considered. Typically the following are of importance.

Size of the proposed subdivision.

The traditional business breakdown into marketing, production, finance, control, and like functions.

The technologies involved.

Diversity of activity in the proposed subdivision.

Separation of managing from nonmanaging work.

Geographic location or sites of subdivisions.

Management desires with respect to proximity of decision and action areas.

Company organization philosophies such as thrust toward centralization or decentralization, organization in terms of communication flows, organization around decision centers.

Functional relationships. An example is the interrelationships between procurement, work scheduling, work-in-process inventories, and finished product inventories (sometimes called industrial logistics).

Facilitation of the "exception principle" concept in management.

Separation of staff from line activities.

Rate and character of change in the industry or the business.

Abilities of people available in the company or locality.

The significance of most of the foregoing considerations is self-evident. The degree of importance or extent of applicability frequently varies. The need for a unit of manageable size is obvious. But what constitutes manageable size varies. If the activities of the subdivision are all much alike, the "span of control," the horizontal scope of responsibility, can be much broader than if the activities for which the subdivision head will be responsible are varied. The concept that there is some single magic figure that represents the optimum number of people one individual should have reporting to him no longer is universally acceptable. At the lowest supervision level we find foremen successfully responsible for anywhere from 10 to 100 workers. If all workers are doing the same thing, if their work is routine, if the activity seldom changes, the foreman finds less supervision per worker necessary than is true where each worker has frequent and diverse problems that necessitate the attention of the foreman. Thus to say that one foreman should supervise 20 workers—or 15 or 25—is an unfortunate generalization that rests on gross oversimplification.

Similarly it is no longer possible to rely completely on the classic functional breakdowns of business management as sole determinants of effective organization. Technological advances and social changes in various areas tend to reduce some of the old dependables to matters of lesser import in task subdivision. The ability of the computer to provide large amounts of information quickly and cheaply is bringing with it organizational changes in the area of control. The growth in economic strength of unions and their ability to exert government pressures have brought about a separation of company-union relations from the personnel department in a large number of companies. Environmental change has made this organizational change desirable. In many businesses the increase in research activity has resulted in an organizational separation of research from product development so that the long-established "R and D" department has been divided into two activities, each with its own responsible head. The primary subdivision of business management into production, marketing, finance, and accounting still predominates and in the foreseeable future will continue to do so. But in addition to these, new areas of equal concern are emerging to take their place beside the long-established ones. Of these newcomers industrial relations, public relations, research, and executive development are most frequently observed today.

Scientific, economic, and social changes seem likely to intensify concern with job technology as a determinant in task delineation. The technological skills of the comptroller are quite different from those of the sales manager. The factory manager utilizes techniques that differ greatly from those of the sales manager and the comptroller. In these, and the other areas of specialized business responsibility, the technical content is undergoing continuous and rapid development. The progress of technology is cumulative, and its impact on responsibility specialization at supervisory and executive levels seems likely to continue to increase. With the development of better understanding of the differences between the managing and the nonmanaging work of corporation officers, there has come concern about the practice of requiring that one individual perform both types of functions. Today, in many—perhaps most—situations it is not feasible to practice complete separation. However, the trend seems to be for separation of these two kinds of work and as business management becomes increasingly complicated more such separation is likely to be found in job delineation.

Increased interest and research in the behavioral sciences are resulting in the emergence of new concepts or philosophies of organization structure. The idea of basing subdivision of the total task on decision centers—the points at which decisions actually are made—or on the basis of information interflow is receiving increased attention. Decentralization of management responsibility, of considerable prevalence recently, has been judged by some to be an organizational fad. The trend probably was triggered by the postwar tendency of prosperous concerns to diversify their activities. However, among the larger, more thoughtfully managed corporations one can observe fundamental and far-reaching changes that have their origin in the work of social scientists interested in organization theory. Decentralization of decision making and bringing decision making closer to the point at which resulting action will be taken are current practices that have their fundamental basis in the newer organization theories. These are no fads. Certainly there have been excesses and ill-conceived applications, but the major thrust of such changes rests soundly on advanced theory and on experience. In many instances these concepts of organization are paying off.

In many businesses, staff services are growing. Increase in technological knowledge and its utilization probably make this inevitable. The older concept—borrowed from the military—that the "staff advises and the line decides and acts" no longer is adequate. The new element in this picture might be characterized as the "authority of knowledge." The nonline divisions in modern business organizations might most properly be designated as service units. This is true at all organization levels. The industrial relations department that reports to the president is a service group. So too is the quality control unit that reports to the assembly department head, or in the case of the more embracive quality control section, to the factory superintendent.

These modern service units perform several functions. They are research units in the sense that they develop new methods, procedures, standards, units, and systems of measurement. In this capacity they are exploring into the future, beyond current practices and present problems. With respect to existing needs of the operating structure of the business, they provide consulting service and often training to secure the maximum benefits from current applications. Many service units meet corporate needs beyond the capacities of line executives. The legal department, the corporation accounting department, and the research division are examples. Most often they do not exercise authority in the sense that they dictate action. They rarely say, "Do this." More often their work results in advice such as "If you do this, these will be the results," or "If you do not do this, you should expect this to happen." In one sense their authority is most limited or nonexistent. Yet their influence on action decision is great. Theirs is the *authority of superior knowledge*. As such the influence of their work is great and, when properly conceived and their work clearly defined, there is none of the classic "conflict of line and staff."

Whole books, important books, have been written on this area of organization structuring. All that is attempted here is to outline the scope of the problem. Most simply stated it is a matter of work specialization at management levels. And inherent are all the gains and problems that stem from all specialization of human activity.

B. POSITION SPECIFICATIONS

Time and again, when asked for his company's organization chart a top executive will say that there is one, but that it is sadly out of date. Or the reply to the request not infrequently is "We do not have one; this business changes so rapidly that any chart would be inaccurate even before it was completed." While he does not realize it, what the executive actually is saying in such replies is that neither he nor those who assist him (his organization personnel) know precisely what responsibilities and authorities each has. If the division of the total business task has been carried out to the point where the responsibilities, authorities, and interdivision relationships of each subdivision have been completely and clearly determined, and so stated in the form of a written job specification, preparation of an organization chart is a routine procedure, clerical in its nature. Without such formal task descriptions, an accurate organization chart is impossible. Invariably the company that has developed precise job descriptions will have a currently meaningful (and useful) organization chart. Likewise any organization chart that does not rest on currently accurate position guides is suspect, often worse than useless. All of which is just a way of saying that the organizer's task of breaking down the total job certainly is incomplete until expressed in terms of written specifications.

To be adequate and useful, a position specification must state all responsibilities involved explicitly and clearly. It must state all authorities granted. One useful mode of defining authority is to specify the grant of "all necessary authority" with the exception of explicit authority withheld. It has been found in practice that this method results in fewer uncertainties than the practice of stating in detail the authority granted. Just as important as specifying authority and responsibility is a complete and unambiguous statement of important relationships, both with individuals and with other subdivisions: to whom the position head reports, what reports should cover, and when they are to be made. To considerable extent these reports can be helpful in measuring the effectiveness of the incumbent. This should be made clear. A position guide also should clarify all relationships of the holder of the position with any subfunction subordinates who report to him. To say that the preparing of position guides of the character and to the extent here described is an impossible task literally is not true. There are corporations in this country with executive payrolls that include over 15,000 people each one of whom has in his possession a job specification fully as elaborate as those described here. One gain experienced by companies that have such programs is a considerable freedom from the necessity of making organization structure or task changes. The reason for this is not entirely clear. It would seem that detailing job specifics would make for rigidity that would call for frequent change. That the reverse is true probably results from the greater thought that goes into the preparation of written task specifications and the uncertainties that must exist when such specifications are not worked out.

Position guides should be placed in the hands of all executives who have need to know where specific responsibilities and authorities rest. Often this publication takes the form of loose-leaf manuals kept current by updated replacement sheets distributed to manual holders. When this is done, all executives and supervisors can be held responsible not only for their own tasks but for intertask relationships that concern them.

9. STAFFING

The existence of systematic position guides helps greatly to take guesswork out of staffing. It is much easier to match abilities of individuals with position requirements when the needs of the task are known in detail. Even then selection and promotion are as much art as science. Systematic periodic personnel rating can help. But this must be done carefully, and raters must be trained (and frequently refreshed) if the results are to be helpful. Many rating systems have become worse than useless in the sense that inaccuracies mislead. There is much literature on this subject available to any executive who seeks it. These publications cover methods, gains, risks, and policies.

With respect to the last of these, we will here confine comment to one aspect only. One of today's major management responsibilities is perpetuation and growth of the people who make up the line and service organizations. A policy of assigning personnel to tasks somewhat beyond their immediate capabilities can be one means of fostering growth both of individuals and of the organization as an integrated whole. To do this effectively calls for perception, knowledge, and judgment. The job should stretch the new incumbent; otherwise he will not see it as worthy of his best effort. At the same time the requirement must be attainable for the selected individual. Otherwise he will become frustrated and eventually may stop trying. The loss from such a result may be fully as great as the losses from poor decisions made by the incapable incumbent. The reason for this lies in the fact that lack of success may cause the individual to lose confidence in himself. Or, what is more probable, to cause him to shift the blame from himself to the company, or to his superior. What may potentially be valuable personnel capacity may thereby be lost to the company. This loss is of long-range duration and, most serious of all, can be contagious.

10. RECAPITULATION

Discharge of management's work of organizing requires a four-step process: delineation of the total task to be accomplished; breakdown of the total task into manageable subdivisions, which inevitably results in specializations either of function or scope of activity; preparation of clear, explicit position specifications which cover objectives, responsibilities, authorities, and relationships involved; selection and assignment of individuals to specifically defined positions. Such specifications make that oldest of oganization tools, the organization chart, meaningful and useful. The manager has no more important task than organizing. Nor does his work include any activity more productive of growth and enterprise profit. Alone, it does not assure success of the business. Organization will be effective only when planned in terms of well-defined corporate objectives and policies. Equally essential are those other managing activities, motivation of people and control of activities through devices of over-all action auditing.

11. THE ATLANTIC-UNION CASE

The precase discussion of this chapter's topic has been much more elaborate than has been true of other chapters. This is because of the very broad scope of the subject, organization. Such breadth of context makes it impractical to discuss a single case that comes even close to being concerned with all aspects of organizing for business management. The Atlantic-Union Company case has been selected for discussion here because it is concerned with some of the more major current problems of organization, problems that become more insistent as the size of a business increases.

In 1955 the Atlantic-Union Company was twenty years old. The company had grown steadily and had expanded its activity into many fields, most of which were directly or indirectly concerned with the generation or use of electric energy. During the first 32 years of its existence its predecessor, the Atlantic Company, had been owned by three brothers who had originally started that enterprise. Following the death of the youngest of the three founders, ownership and control were in the hands of the estate trustees. During the three years that the estate attempted to operate the several manufacturing activities that made up the company at that time, substantial losses were incurred. The heirs wisely sold their interests to a competitor, the Union Company of the East, Inc. The Atlantic-Union Company was the result of this consolidation.

12. THE 1955 ORGANIZATION

Like its predecessors the Atlantic-Union Company was managed by a small group of able executives. Exhibit 1, page 634, shows this centralization of control at the extreme top of the organizational structure as it existed in 1955. At that time the company was made up of 12 divisions, each under a general manager who reported to the executive vice-president of the corporation. The company operated 87 plants, 2 mines, and a customer financing organization with offices in 18 cities. All major policies, most major operating decisions, and many relatively minor decisions were made by the 12 general managers and the corporate executives at the president and vice-president levels. As shown in Exhibit 1 this group consisted of the following men:

President
Vice-president for marketing policy
Vice-president for manufacturing policy
Vice-president for engineering policy
Vice-president—industrial and personnel relations
Director of advertising and publicity
Director of purchasing
Director of the research and engineering laboratories
Director of the legal and patent department
Comptroller
Treasurer
Executive vice-president

All appointments at salaries in excess of $7,500 a year had to have the final approval of a division general manager. Any expenditure in excess of $25,000 had to be approved by the comptroller on recommendation of a general manager. Plans for any substantial plant expansion required the approval of the executive vice-president. Yet the company's 107 factories, mines, and finance company offices were located in 32 states and 5 foreign countries. No company official ever had visited all these installations. There were plants that had never been seen by any company executive above the general manager level.

Each general manager was responsible for a number of allied product operations. The home appliance division was typical. The general manager of this division had 15 department managers reporting to him. These consisted of:

Manager of the vacuum cleaner manufacturing department
Manager of the fan and clock manufacturing department
Manager of the radio manufacturing department
Manager of the home refrigerator manufacturing department
Manager of the home laundry equipment manufacturing department
Manager, dishwasher manufacturing department
Manager, home air-conditioning equipment department
Manager, water heater manufacturing department
Manager, range manufacturing department
Manager, small appliance manufacturing department
Sales manager
Advertising manager
Manager, customer services
Credit manager
Manager of the accounting department

The sales manager was responsible for the marketing of all products produced by the 10 manufacturing departments of the home appliance division. He served three territories: eastern sales, central sales, and western sales. Each territory was the specific concern of an assistant sales manager who reported to, and worked closely with, the division's sales manager. The advertising manager, the customer services manager, the credit manager, and the accounting department manager each had division-wide responsibility.

Each manufacturing department manager was responsible for all production functions of one or more product lines. The home air-conditioning department manager was typical although his department was smaller than some of the others. Eleven section managers reported to him. As shown in Exhibit 1 these were:

Safety section manager
Product engineering and design section manager

Exhibit 1 Atlantic-Union Company

Executive and Supervision Organization—1955

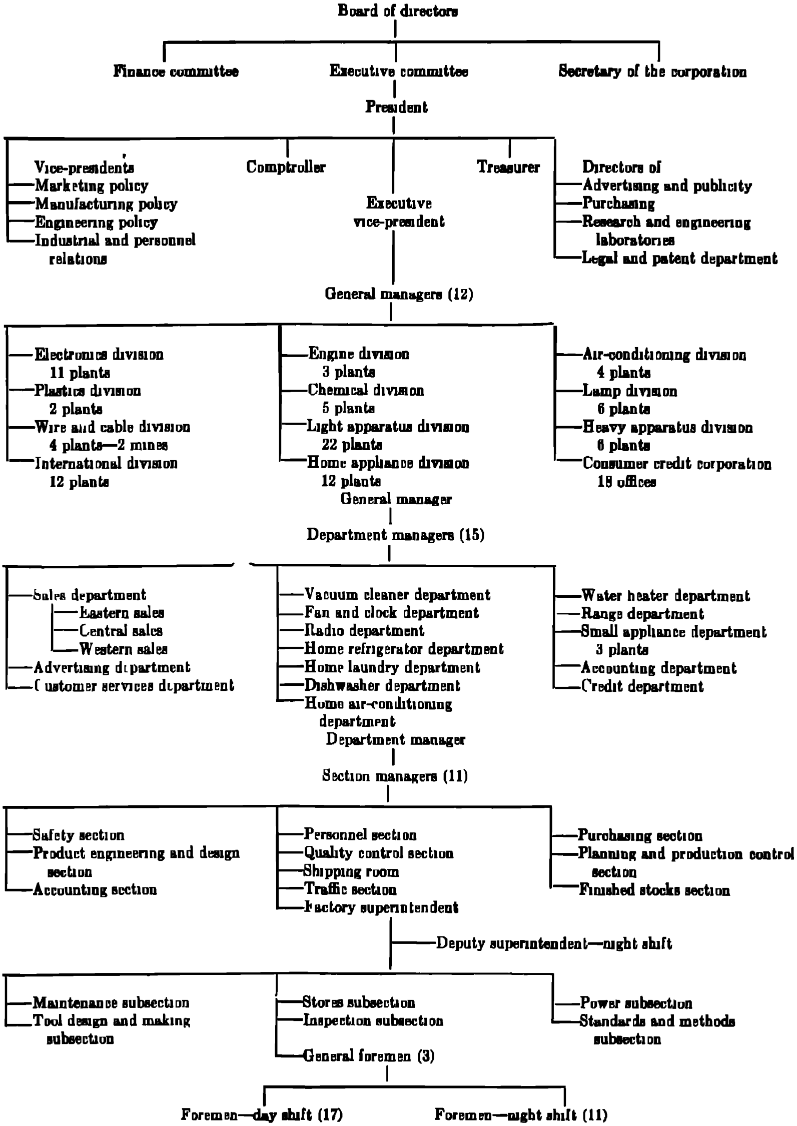

Exhibit 1 *(continued)*

Atlantic-Union Company

Comment on the 1955 Executive and Supervision Organization

Board of Directors Level

The activities of the five-man executive committee had reduced the actions of the board to rather ineffective formalities.

Vice-president Level

Policies to be followed throughout lower echelons are formulated at this level. The executive vice-president, responsible for all line activities, clearly is overloaded.

General Manager Level

Each of the 11 product division general managers is responsible for all aspects of a wide range of products produced in a large number of plants. The home appliance division manager is typical. He has 10 product producing department managers reporting to him. He has a single sales department that sells the products of all 10 producing departments. One department advertises for all, and a customer services department, an accounting department, and a credit department serve all product departments. For financial resources, each of the 12 division general managers goes to the president through the executive vice-president who actually has little knowledge of the needs of the divisions and their departments.

Department Manager Level

Each department manager—there were 90 of them—was responsible for the production of a line or lines of product. Typical examples were vacuum cleaners, radios, water heaters. Each department manager has section managers reporting to him. Nine of the 10 section managers reporting to the home air-conditioning department manager are responsible for typical manufacturing staff functions such as purchasing, planning, and production control. The tenth section manager reporting to the home air-conditioning department manager is the factory superintendent responsible for all factory operations.

Accounting section manager
Personnel section manager
Quality control manager
Purchasing manager
Planning and control section manager
Finished stocks section manager
Shipping section manager
Traffic manager
Factory superintendent

Atlantic-Union's laboratories, headed by the director of research and engineering, did mostly basic research. Its engineering activity seldom went beyond demonstrating functional feasibility of an application. Product design work was the responsibility of the product engineering and design sections of the various product manufacturing departments of the several divisions. Thus the home air-conditioning department of the home appliance division and the central air-conditioning department of the air-conditioning division each had an independent product design and engineering section. These sections were responsible for all design aspects of the products of their divisions: functional design, design for market appeal, and design to assure ease of manufacturing.

The Atlantic-Union Company's industrial and personnel relations vice-president had two major responsibilities. He carried out all contract negotiation with the many unions that represented the company's workers. This activity was carried on at the top management level exclusively to make sure that company-union contract relations were kept uniform throughout the corporation. Otherwise unusual union bargaining strength at some local point might result in unusual concessions from management at that plant. The union then would work to get these concessions extended throughout all plants, thereby creating widespread unsettled relations. Centralized contract negotiations made for uniformity and stability of union-company relations throughout the corporation.

In addition to negotiating union contracts, the industrial and personnel relations vice-president was responsible for the development of personnel policies and their utilization throughout the company. Personnel management activities were left to the personnel managers at the section level. These men knew local conditions, requirements, and practices and as a result were in a good position to make decisions that would reflect the local situation.

Policies from the vice-presidential level assisted them as guides, but as guides only. For example, all section personnel managers knew that with respect to wage rates it was company policy to pay wages at least as high as the going rates in the community. To assist them further in fixing specific rates, they had been provided with an approved wage structure that included wage rate ranges for jobs at various levels of skill requirements and the like. A section personnel manager thus was able to set job rates that would assure him of competitive position in the local labor market, minimize relative wage dissatisfactions within his own work force, yet keep his wage levels consistent with those of other company divisions. Top management determined the policies; their application was a matter of judgment at the local level. This was the organizational principle involved.

A comparable relationship was expected to exist between other top level executives and executives at the department and section levels. The corporate director of advertising and publicity was responsible for creating an image of the corporation as a whole "and for setting policy guide lines to assist divisional advertising departments."

In many instances the influence of top executives had gone much beyond this. Top control over expenditures and salaries often resulted in overriding the preferences of executives at the operating levels. It was not uncommon for executives to deny (or grant) budget requests simply because of ignorance of actual requirements at a host of widely diverse local levels.

Throughout Atlantic-Union, manufacturing process control was exercised at the section and subsection levels. Each product department general manager had one or more factory superintendents reporting to him. The manufacturing organization of the home air-conditioning department shown in Exhibit 1 is typical. All other department managers throughout the 12 divisions had similar, although not necessarily duplicate, facilities.

The factory superintendent of the home air-conditioning department was fully responsible for all the department's production activities. He was assisted by a deputy superintendent who assumed the superintendent's responsibilities and authority for the night shift operation, six functional subsection supervisors, and three general foremen through whom he was responsible for the work of 28 foremen. There were over 1,200 direct and indirect workers on the factory payroll. The success of the factory superintendent was closely related to and influenced by the activities of most of the department's other sections. Quality control, purchasing, planning, and production control were sections typical of this relationship. In general it can be said that the factory superintendent's is a line activity. He is responsible for getting things done, products produced. There are few service functions under his direct control. Most of the manufacturing functional (staff, service) departments were at the section level. Their managers, like the factory superintendent, reported to the department manager. It is difficult to see why some of the subsection functions were not at the section level. The power subsection is a typical example.

13. DIFFICULTIES INHERENT IN THE 1955 ORGANIZATION

The rapid growth of the Atlantic-Union Company and the increased diversity and complexity of its business had created a situation that made it extremely difficult for the 1955 organization to function effectively. Both sales and total profits had been increasing. But profit per dollar of sales was less than half what it had been five years earlier. Likewise profit per dollar of resources in use was diminishing and annual returns on stockholders' investment had shrunk. Members of the board of directors and certain of the corporation's top executives were well aware of this situation and were greatly disturbed by it. At a special two-day meeting of company executives with the executive committee of the board, the situation was subject to a penetrative exploration. A decision to reconstruct the administrative organization was reached, and a plan to attack the problem was prepared and shortly thereafter submitted to the board. At its January meeting in 1956 the board instructed the president to proceed with the development of a management structure that would meet the problems of the company, problems that by that time had become clear to all concerned. Many executives were attempting to carry an overload of responsibility. Operating decisions were being made by top executives on the basis of totally inadequate information. Top executives were making far too many decisions and as a result were unable to address themselves to the company's needs for longer range planning. In essence, management was too highly centralized at the top. The president and his immediate associates were to effect administrative changes that would tend to meet such clear deficiencies.

In the years immediately following, many organization changes were made. These were put into effect gradually, as rapidly as executives involved could adjust themselves to new responsibilities and new authorities. By 1961, most of the desired changes had been made, and as a result the profit picture already was improved.

Comparison of Exhibit 1 with Exhibit 2 on page 640 will reveal both the changes made and the philosophy upon which they were based. Following is a commentary on what was done.

14. HOW THE 1961 ORGANIZATION DIFFERED FROM THAT OF 1955

The nature, extent, and goals of the organization changes made during the period 1955–1961 best can be seen by comparing the organization structures indicated by Exhibits 1 and 2. Complete description of all changes would be too voluminous for inclusion here. Therefore only pivotal changes and illustrative examples will be cited. It is hoped that such comments will make a more thorough comparison possible.

15. CHANGES AT THE BOARD LEVEL

No change was made in the basic functions of the board. In the past membership had been about equally divided between "outside" and "inside" members, and this balance between outside influences and operating personnel intimately familiar with company operations was retained. The executive committee of the board was discontinued as being unnecessary in the light of other organization changes, and the president reported directly to the board instead of to them through the executive committee as had been the case in the past. It was believed that this change would bring the entire board membership into closer relation with the corporation's problems; the board was expected to make a greater contribution to the conduct of the business.

16. CHANGES AT THE PRESIDENT LEVEL

The new organization provided the president with a consultive and policy-making body made up of key company executives. As indicated in Exhibit 2, this group consisted of the top operating and corporate executives of the company. Its activities were to be confined to a consideration of over-all problems, with particular reference to coordination of product department relationships and plans for the future of the business. The results of its deliberations would be policy pronouncements and a minimum of operating directives. Current operating problems would be considered only to the extent of their impact on the future. By confining their activities in this way, it was believed that the company would have a better coordinated direction and a more effective leadership.

17. CHANGES AT THE VICE-PRESIDENT LEVEL

The office of executive vice-president was discontinued. Perhaps it is more accurate to say that this position was subdivided into five parts, each a product group headed by a group vice-president. Product lines with similar markets were grouped together. The consumer products division is an obvious example. Five new vice-presidencies were created, each to have responsibility for a product group.

The office of vice-president of engineering policy was discontinued. Part of the work was transferred to the new vice-president in charge of the research laboratories. The rest of the activity was divided up among the department general managers. Each department general manager took over responsibility for the engineering work concerned with the product lines for which he was responsible.

In like fashion the office of director of advertising and publicity was discontinued. Each department general manager assumed responsibility for advertising of the products for which he was responsible.

The office of director of purchasing likewise was discontinued, the responsibility being absorbed by the various department general managers.

The company's research laboratories were completely reorganized. A vice-president in charge of research was made responsible for all basic research and all research expected to be of value to more than one product department. All product design and development work was removed from the research laboratories and transferred to the control of appropriate department general managers. The equipment and personnel devoted to product development and design were moved to the product department plant locations.

The policy function of the manufacturing policy vice-president was transferred to the various product department general managers. The services functions of the manufacturing policy group were set up as a new office, that of manufacturing services. This essentially was a research organization. Its position guide indicated that it was to concern itself with the development of new manufacturing techniques such as quality control, work measurement, and the like. It was to work in terms of future developments only and was not to concern

Exhibit 2 Atlantic-Union Company

Executive and Supervision Organization—1961

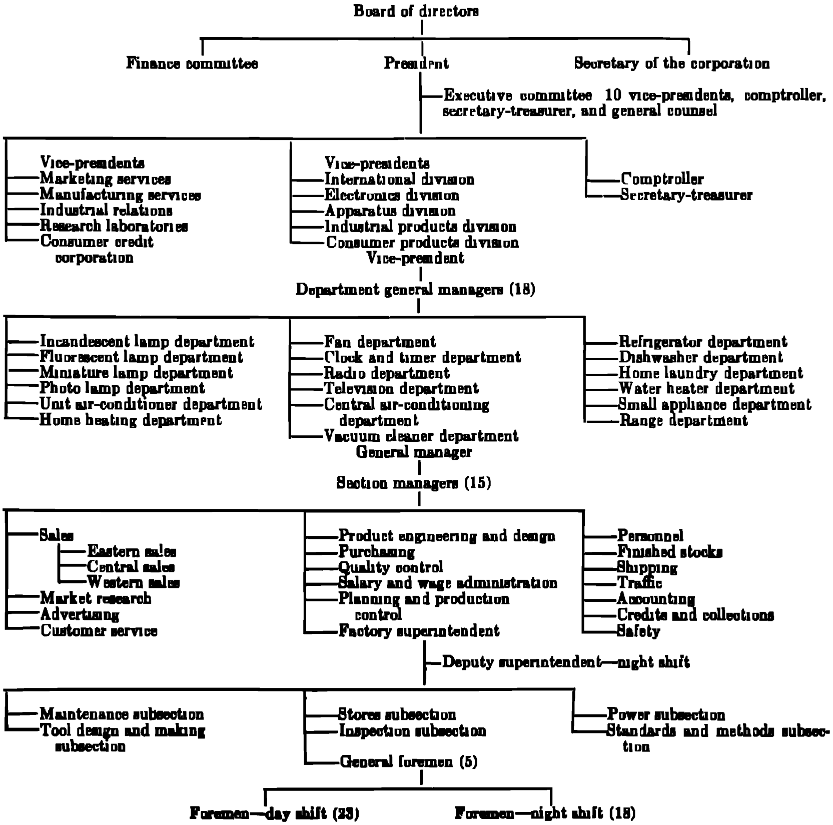

Exhibit 2 (*continued*)

Atlantic-Union Company

Comment on the 1961 Executive and Supervisory Organization

Board of Directors Level

The executive committee of the board had been discontinued with the result that all members of the board had become more active and influential

President Level

The president now reported directly to the board as a whole He had the assistance in policy formulation of an executive committee comprised of 10 operating and services vice-presidents and the 3 other corporate executives As a body this group was responsible only for major company-wide policies and for planning the future goals and activities of the company.

Vice-president Level

The executive vice-president had been replaced by five product division vice-presidents, each responsible for a group of related products This eliminated overload and gave top management much closer contact with operations Other vice-presidents were in charge of industrial relations, the research laboratories, marketing and manufacturing research services. Three other corporation-wide staff executives were retained

Department General Manager Level

Each of 88 department general managers had complete responsibility for marketing, production, and operating finance of one or two products Actual operations were completely decentralized at this level Each department general manager was an independent operator, fully responsible to his division vice-president for the profit showing and growth of his activity Each had his own marketing, manufacturing line and staff, and operating finance and personnel sections Each was responsible for and had authority over a complete self-contained business activity This was complete decentralization at the product level

itself substantially with current operations in product divisions. In each division current problems would be the responsibility of a standards and methods subsection under a subsection supervisor. The manufacturing services organization would provide consulting service to the standards and methods subsections, but only when called upon to do so by the factory superintendents. In addition manufacturing services would make new developments known to the appropriate subsections. Its activities were to be basically research and making the results of their own researches and other advanced developments available to the operating people when requested.

In similar fashion the marketing policy function was changed to a marketing services activity. Its policy work was discontinued, and it became a service organization available to sales and marketing sections of the product departments.

The personnel responsibility of the 1955 industrial and personnel relations vice-president was transferred to the personnel sections under the product department general managers. The vice-president of industrial relations confined himself to union contract negotiations and to any work cessations that could not be resolved satisfactorily at the department general manager level.

18. CHANGES AT THE DEPARTMENT MANAGER LEVEL

Perhaps the most significant development of the 1955–1961 period took place at the department manager level. In 1955 each of the 10 product section managers reporting to the general manager of the home appliance division was essentially a manager of manufacturing. The output of the home air-conditioning department was marketed in common with the outputs of the nine other product departments by one sales organization responsible to the general manager of the home appliance division. Essentially the responsibility of the home air-conditioning department manager was limited to the production of home air-conditioning equipment. If home air-conditioning equipment did not sell well in competition with other producers of similar equipment, there was no one in the entire Atlantic-Union Company who could be held exclusively responsible for the failure. In 1955 the sales department could focus the blame on the home air-conditioning department manager for "not producing a competitive product." In reply, the home air-conditioning department manager might argue that "if the sales department put as much effort into selling air-conditioning equipment as they do into selling refrigerators there would be no problem." No one could be held clearly responsible for failure of air-conditioning equipment to show a profit. In fact it is improbable that it could be demonstrated that the air-conditioning equipment operation had resulted in a loss or in a profit. Put somewhat differently, it can be said that no one knew what effect the manufacture and sale of home air-conditioning equipment had on the profit picture of the Atlantic-Union Company as a whole.

The same statements hold for each of the nine other product departments for which the home appliance division general manager was responsible. The problem was even more widespread than the home appliance division. There were 11 other product divisions, and the conditions prevailing in the home appliance division was to be found in all of them. Profit responsibility was uncertain; "buck-passing" was easy and prevalent. Operating inefficiencies were inevitable.

By 1961 all this had been changed. The general sales and marketing sections of 1955 had disappeared from all product departments of all 10 domestic product divisions. In 1961 each department general manager had his own marketing sections. In the case of the vacuum cleaner department there were four of these: a sales section, a market research section, an advertising section, and a customer service section. The vacuum cleaner department general manager was responsible for these sections just as he was responsible for all sections concerned with the manufacture of vacuum cleaners. In addition he had his own operating finance and over-all control sections. He was truly a general manager running his own business, the manufacture and sale of vacuum cleaners, with complete facilities for the financing of these functions. Essentially he was running a separate business for which he had complete responsibility. He could use the facilities of the corporation's manufacturing services, marketing services, and research laboratories or not just as his judgment indicated. If he did use these services he paid for them, and the costs appeared as such in the operating statements of the vacuum cleaner department. Whether or not vacuum cleaner operations were profitable was the responsibility of this one general manager. Profits or losses were determinable as accurately as are any profit or loss results. His performance was measurable, and he was rewarded just in proportion as results showed that he was or was not an effective manager.

It should be made clear that there were certain restrictions on these 88 essentially independent department general managers reporting to five product division vice-presidents. They had to conduct their operations in conformity with certain general company policies. For example, they were expected to buy any needed components from one another if these components were produced within the company. However, they were not required to do this if a component could be obtained from outside the company and the in-company source was unwilling to meet the price of the outside potential supplier. Also they were subject to certain directives handed down by the corporation's executive committee. An example was a prohibition against more than one product department producing the same item for sale in the outside market. The executive committee delineated the product areas of each product department, and general managers were required to confine their sales activities outside the company to these prescribed product areas. However, if he found it desirable a general manager could produce a component for inclusion in the products he sold in the market even when this component was produced and sold in the market by some other product department. The vacuum cleaner department produced the electric motors that went into cleaners even though its product charter forbade it to sell fractional horsepower motors in the small motors market. Such policies and directives from the executive committee were restrictive in a sense. But they were essential to the welfare of the company as a whole. Rarely were they a handicap to the product department general managers.

Certain authorities withheld from the general managers were of benefit to them. General managers were forbidden to go into the capital market when in need of funds. When money was needed for expansion, or permanent improvements, or for excessive seasonal operating peaks, a general manager was required to seek such funds through his division vice-president from company sources. Atlantic-Union could obtain funds in the financial markets more cheaply than could any one of the 88 company general managers. Thus this restriction actually worked to the benefit of the general managers.

All union contracts were negotiated by the company's vice-president in charge of industrial relations. This again was beneficial to the general managers. As a whole the company had greater bargaining power than any one company product department. Also centralization of contract negotiations relieved the general managers of the time-consuming pressures of union contract agreement.

Few other centralized activities restricted the freedom of the general managers. Thus marketing and production were the full responsibilities of these executives. In almost all respects they could be considered to be completely independent, self-sufficient operators.

This was the great change that took place at the 1955 department manager level. It was a complete reversal of the centralized organization concept that had prevailed up to 1955. If any one change was of outstanding importance in producing the betterments that were clear in 1961, it probably was this decentralization of management which made it possible to determine results, fix responsibility for results in terms of explicit delegation of responsibility and authority downward and outward.

19. ORGANIZATIONAL GAINS, 1955 TO 1961

The basic organizational changes brought about in the Atlantic-Union Company during the period 1955 to 1961 were of four kinds. Tasks were redefined in terms of total scope and character of context. In 1955 many of the responsibilities assigned to individuals were excessive, beyond the scope of individual accomplishment. When the task of the executive vice-president was broken into five separate parts on a product-type basis, the extent of responsibility of each of the new division vice-presidents was much less than the scope of the responsibility of the executive vice-president. This made for fewer decisions per executive and for sounder decisions. Further gains resulted. Reduction in problem diversity followed segregation of products into five groups that recognized major marketing differences between groups. This resulted in less diversity of problems within each group. The task of each division vice-president was much more accomplishable than that of the executive vice-president because the extent of responsibility was less and the problems were less diverse.

Communication within the 1961 structure was easier and more accurate than was true of the 1955 organization. In 1955 seven levels of authority separated the president from factory workers. In the 1961 structure one of these was eliminated so that channeled communication between top and bottom was reduced to six transmission points. The fewer the centers through which communication must pass, the more likely it is that the message will be accurate when it reaches its goal.

Lateral communication became easier when the sales functions were decentralized by product lines. Communication between radio sales and radio design was much less cumbersome when the two activities were both within the radio department than was the case in 1955 when radio sales was a division function and radio design was a department activity.

A third reorganization gain was a rather drastic decentralized concentration of responsibility. The 1961 general manager of the vacuum cleaner department (for example) was responsible for all operating aspects of an independent business. He could be held responsible personally for the profits of the vacuum cleaner business and for the progress his operation made in its highly competitive market. He controlled his own selling, production, operating finance, and personnel functions. The results obtained by the department were measurable and were attributable directly to the planning, organizing, motivating and integrating, and auditing skills of the department manager. This executive had clearly defined responsibilities and had at hand the facilities necessary to meet these responsibilities. His authority was commensurate with the responsibilities he faced.

Finally a major feature of the 1961 structure was bringing decision making closer to the point at which action resulting from a decision would be taken. In 1955 marketing policy formulation with respect to vacuum cleaners was located one organizational step below the presidential level, three steps above the level at which vacuum cleaner design was determined. The 1961 organization made vacuum cleaner marketing policy determination and vacuum cleaner design common responsibilities of the vacuum cleaner department general manager. The result was a far more effective integration of policy decisions, design development, and design execution. Betterment of decisions made was inevitable.

These four changes were a great step forward. Better determination and delineation of total tasks, easier and more rapid and accurate communication flow, decentralized specialization of responsibility and authority, and bringing decision making and action taking closer together were sure to effect results for the better. They were major organizational gains.

20. ORGANIZATIONAL PROBLEMS OF THE 1955–1961 PERIOD

The development and implementation of the 1961 organization structure were neither simple nor easy. Most of the problems encountered were problems with people. Over 100 of the company's major executives found their jobs changed drastically. They had new responsibilities and new authorities. In many instances they gave up authorities to which they had been accustomed for a long time. Eighty-eight general managers found themselves needing knowledge and skills foreign to their training and experience. The results of their actions now were measurable; it was another new experience to face almost daily concrete evidence of their successes and failures. These executives soon realized that they had much to learn. The idea of the new operating independence and freedom was appealing to them. To some it came as a shock to find that this freedom of action entailed responsibilities that were new and in some cases little understood at the start. In most instances these new officers rose to the challenge. They made mistakes, but found that they could identify them quickly. Likewise they found that their successes and their progress were readily discernible both to themselves and to their superiors. By 1961 this learning, developing period was under control in most cases. But in no sense had it been easy. In addition to the new tasks to be accomplished, there were new organizational relationships to be understood and utilized. And over-all there was an entirely new organizational and operational philosophy to be grasped, to be understood, and to be accepted as a way of daily business life.

Not all the 1955 executive personnel found it possible to make these changes. People who found themselves in positions to which they could not adjust were shifted to more suitable spots whenever possible. Still there were a few early retirements and a few resignations. By 1961 these troubles seemed to be over, and a well-established, integrated, and personally satisfied group manned the organizational structure. The change had been difficult, but the outcome properly was labeled a success.

21. SUMMARY AND CONCLUSIONS

Earlier in this chapter it was pointed out that the manager's work of organizing entails four distinct although obviously interrelated and sequential steps. These were the clear and inclusive delineation of the total task to be accomplished; breakdown of the total task into explicitly defined, mutually exclusive operational subdivisions;

preparation of written and published job descriptions and position guides; and finally the selection of people to fill each position as defined. Whatever may be one's organizational philosophy, these four steps always are involved. Earlier in the chapter the nature of each of these four steps was discussed in some detail. The experience of the Atlantic-Union Company in redesigning its organizational structure involved all these functions of organizing. All four have been touched upon in describing the Atlantic-Union experience, but not all have been developed in equal detail. Atlantic-Union prepared detailed position guides for all assignments in the new organization. These were not covered in the discussion of the case. For an example of these position guides the student is referred to Exhibit 2 of the National Union Company Electronics Division case on page 465. This is an exact copy of a position guide for a supervisor in the quality control department of a different division of the company. All job descriptions and position guides prepared in the Atlantic-Union Company were comparable.

The inherent function of business management is to perpetuate the effective production and distribution of products and services at least real cost to consumers. The essence of this activity is producing and marketing. But to produce and market on an effective basis necessitates other, and distinctly different, types of activities. Financing, purchasing, hiring, research, product design, manpower development, and many others are equally essential activities. Businesses do not exist for the purpose of purchasing materials and supplies, or of buying equipment, and like activities as ends in themselves. But these commonly become major tasks in a manufacturing business. As business has grown in size and increased in complexity, it has usually become beyond both the time and the "know-how" capacity of a single individual to be effective in all these essential activity ramifications. It is this development that has made organizing so important. The goals are the determination of objectives and the combination of interrelated specialists into a whole that functions as an entirety rather than as an accumulation of parts.

Organization structure always should be designed to meet the needs of a particular situation. The structure that seems best under one set of circumstances would be inappropriate, perhaps unworkable, under some other set of conditions. Furthermore any situation at any point in time is sure to change. Organization must constantly evolve to meet the requirements of change. Thus organizing is a constant managing activity. Drastic changes such as those described in the Atlantic-Union Company should not be necessary, but occasionally they are. Far better that essential organization change be evolutionary.

QUESTIONS

1. What is organization?

2. Why is organization so pervasive throughout Western society?

3. Explain the statement: "organization is an application of the specialization concept."

4. Are the gains and losses from specialization as applied to executive and supervisory activities similar to those of specialization at the "worker level"? Explain.

5. What is the most usual basis for dividing up the work of managing a manufacturing company? Why is this basis so commonly found?

6. Why is it so often said that "fixing of responsibility and delegation of authority should go hand in hand"?

7. What part does business policy play in the functioning of an organization?

8. "No organization should exist merely because it is a 'sound form of organization.'" Explain the justification and significance of this statement.

9. What is the objection to an "inflexible business organization"?

10. Be prepared to discuss the following assertion. "The less organization required to meet the need adequately, the better from the standpoint of the exercise of executive control."

11. What are the four essential steps in the process of organizing? In what sequence should they be undertaken? Why are these steps "essential"?

12. What is involved in each of the four "essential steps"? Be prepared to discuss the importance of these considerations for each step of the organizing process.

13. What is meant by the statement that each person in an organization should be able to "get his arms around" his job?

14. Be prepared to discuss the various bases for task subdivision listed on page 626.

15. The phrase "span of control" long has been used to indicate the number of subordinates an executive or supervisor should have reporting to him. The text argues that there is no such "magic number." Explain.

16. What effect is the rapid growth of technology having on organization structures?

17. Explain the difference between managing and nonmanaging work. Please give examples of each type.

18. What is meant by "authority of knowledge" with respect to staff aspects of organizations?

19. What are the functions of modern "service units"?

20. Please be prepared to discuss the nature, use, and importance of position specifications.

21. Be prepared to discuss the significance of the statement, "We do not have one (an organization chart); this business changes so rapidly that any chart would be inaccurate even before it was completed."

22. What, if any, relationship is there between position guides and organization charts?

23. Please be prepared to explain the following statement. "The existence of systematic position guides helps greatly to take the guesswork out of staffing."

24. Discuss: "the job should stretch the new incumbent."

25. What effect did the growth of the Atlantic-Union Company have on the effectiveness of its organization?

26. Why did the management choose to develop a "decentralized structure"?

27. Just what were the nature and extent of the decentralization feature of the new organization structure?

28. Why was the office of executive vice-president discontinued?

29. In the new organization what changes were made:
   a. At the board of directors level?
   b. At the president level?
   c. At the vice-president level?
   d. At the general manager level?
   e. At the department manager level?

30. What were the changes at each level designed to accomplish?

31. In your opinion does the new organization provide for:
   a. Better fixing of responsibility?
   b. Adequate delegation of authority?
   c. An improved motivation of people in executive and supervisory positions?
   d. Better integration of activities?
   e. Greater ease of managing?
   f. Adequate flexibility to meet future business changes?
   g. Relative ease of communication?
   h. Accomplishment of company objectives?

32. In effecting any drastic change in organization structure, what problems should top management expect to arise? What suggestions have you as to ways of resolving these problems?

33. How can drastic changes in organization structure be avoided?

34. What is the meaning of the phrase "organizational philosophy"?

PROBLEM 63 ATLANTIC-UNION COMPANY (C)

The following questions refer to the interdepartmental relationships described in the Atlantic-Union Company (A) case which starts on page 328 of Chap. 12. Review that case before attempting to answer these questions.

QUESTIONS

1. What obligations do the locomotive engine department and the aircraft engine department have to buy power from the small generator department?
2. With respect to power generation and sales, what obligations does the small generator department have to the Atlantic-Union Company as a whole?
3. In the process of decentralizing at the section level, what should Atlantic-Union have done about the power generating stations and the substations of the aircraft engine, locomotive, and small generator departments?
4. If this organizational problem came to the attention of the corporation's executive committee, what action should they take?
5. What does the situation of the utilities subsection suggest as to potential problems of operating decentralization and to provision for avoiding such problems?

PROBLEM 64 ATLANTIC-UNION COMPANY (D)

Atlantic-Union's successes with decentralization of executive functions had stimulated experimentation with the decentralization concept of organization at the first-line supervision, the foreman, level. The management was considering adoption of this development throughout the company's producing departments.

During the course of the 1955–1961 company-wide reorganization, no basic changes had been made in the factory management and supervisory organizations of the Atlantic-Union Company. Typically a factory superintendent had a number of functional subsections reporting to him. Those reporting to the vacuum cleaner factory superintendent were: the maintenance subsection, tool design and making subsection, stores subsection, inspection subsection, standards and methods subsection, and power subsection. (See the organization chart, page 640.) A factory superintendent usually had a line organization consisting of three to nine general foremen and reporting to them whatever number of foremen were required. From 30 to 40 foremen was a common situation; the highest number was 81.

Personnel, purchasing, quality control, wage administration were specialized functions reporting to the factory superintendent's department general manager.

The situation in the vacuum cleaner department was typical. After the 1955–1961 reorganization the vacuum cleaner department had 10 manufacturing functional sections reporting to the general manager. These were in addition to the line manager, the factory superintendent. Because the factory operated two shifts, the factory superintendent was assisted by a deputy superintendent who took over responsibility for the night shift. In addition to the six functional subsections that reported to him, the factory superintendent had five general foremen responsible for 23 day-shift and 18 night-shift foremen who made up his line organization. There were between 1,000 and 1,200 workers below the foreman level on the factory payroll. (See page 640 for a chart of this organization as it existed in 1961.)

The factory superintendent was a young man—thirty-eight years old—who had a mechanical engineering degree and a master's degree in business administration. Although he was younger than most of the company's factory superintendents, he was one of the most successful. He had adjusted to the 1955–1961 reorganization quickly and was enthusiastic about it. He had devised most of the informational reports that flowed between himself and the vacuum cleaner department general manager and had been both cooperative and active in developing new intersection relationships to meet the requirements of the new situations. His general manager had developed very substantial confidence in him and thought him to be one of the most competent factory superintendents in the company.

As an enthusiast about organization decentralization, the factory superintendent had initiated similar experiments in his own organization. By the end of 1962 he had taken four of his most able younger day-shift foremen and had set them up as independent operators responsible directly to him, not to a general foreman. He had made one of these foremen responsible for what had previously been three separate subsections in the motor assembly operation with a total work force of 53 men and 30 women. To supervise this working group of 83 people, he had given the foreman several assistants as follows:

Two inspectors, assigned from the inspection subsection
One standards and methods engineer, assigned from the standards and methods subsection
One part-time maintenance man, assigned from the maintenance subsection
One stores clerk, assigned from the stores subsection
One scheduling man, assigned from the production control section
One part-time safety engineer, borrowed from the safety section
One half-time trainer, borrowed from the personnel section

The foreman was given full control over these assistants. They had desks just outside the foreman's office. Each assistant dealt directly with the workers. The schedule man worked out daily production schedules from a 10 days' production requirements requisition from the planning and production control section. He assigned jobs to all workers in the subsection and reported completed assemblies daily to the planning and production control section. A copy of this report was given the foreman who, unlike other foremen, took no part in scheduling and assigning work in the subsection.

The methods and standards assistant similarly worked directly with the assemblers. His work was different from what it had been when he was working in the standards and methods subsection. There he had been responsible to his subsection supervisor. When his supervisor received a request from one of the department's 41 foremen for an industrial engineer to set a standard on a new job or revise an unsatisfactory standard on an old job, this engineer, if available, might have been sent by his supervisor to the foreman in response to the foreman's request. He would then study the job, work out a standard method for doing it, and with a stop watch or set of standard-time data tables set a standard time for the performance of the task. From this and a table of graded job rates he could set a pay rate for the job. He turned the results of his study over to his subsection supervisor and then was assigned a new task. In every instance his work started when he was given a specific study to make, and his responsibility ended when he turned over his report to his subsection supervisor.

The subsection supervisor forwarded the industrial engineer's report to the foreman. It then was the foreman's responsibility to see that the worker followed the new method and to satisfy the worker that the time study was accurate and the rate a fair one. If the foreman was unable to persuade the worker, he might have to request a restudy of the job. It was seldom that the engineer who had made the study in the first place was available for the restudy; so another industrial engineer was assigned to the work and the setting of a method and time standard was repeated in full.

The industrial engineer who worked as assistant to the foreman in the experimental motor assembly subsection worked on an entirely different basis. If a worker was not satisfied with the standard or rate on a job he was doing, he did not take his complaint to the foreman. Instead he went directly to the group's industrial engineer who, without any instruction from the foreman, usually could at once undertake a study of the situation. The worker got attention immediately, and because he had developed rather complete familiarity with the tasks in the subsection the engineer's work tended to be more effective and to take less time. What probably was even more important was the fact that the engineer had to "live" with the results of his work. The engineer had to satisfy the worker as to the accuracy and fairness of the results of the study. He kept the worker satisfied by watching the job frequently for whatever time was necessary.

As he became accustomed to his new situation, the industrial engineer spent much of his time observing operations to discover opportunities where improvement was possible. This was something that the engineers in the standards and methods subsection did not do. The foreman's engineer became adept at this, with the result that most conditions that needed attention were detected before a worker complained. He also developed skill in dealing with the workers, something that he and other industrial engineers had not had to do in the past.

After some months, when the workers had become accustomed to taking their standards and rate problems directly to the engineer, it was rare for the foreman to find himself concerned with this phase of supervision. Other foremen constantly were harassed with standards and rate complaints and requests for job restudy. They spent much time in contact with dissatisfied workers. Foremen also found it necessary to consult with the standards and methods subsection supervisor and the engineers in order to obtain the service they needed. The foreman of the new motor assembly subsection seldom found it necessary to concern himself directly with this work. His engineer assistant became skillful in dealing with the workers. The workers, in turn, came to know the assistant and to have confidence in him. They did not always fully approve of the standards and rates he set, but the promptness with which they got service from him convinced them of his interest and honesty.

Initially the engineer had considered his job to be tough. As he gained familiarity with the work in the subsection and established himself with the workers, his responsibilities grew less arduous, and he became enthusiastic about the situation. The foreman believed that not all industrial engineers would have worked out as well even were they as competent technically. He secured a substantial salary increase for his industrial engineer assistant.

One of the two inspection assistants had complete responsibility and authority for maintaining quality performance in the subsection. More inspection was needed than one man could handle; so a second inspector was required. He worked under the direction of the inspector who had been made responsible for the quality of the subsection's output. The foreman was kept informed by means of a simple report prepared for him daily by his chief inspection assistant. Occasionally he discussed this work with the inspectors, but only when an unusual condition occurred did he concern himself directly with the function.

When the new-type subsection was first set up, the foreman had asked for a stores clerk to do the stores control and replenishment work that previously had been done by clerks in the stores subsection. It shortly became clear that this task did not require the full time of one person. Within three months the foreman's scheduling assistant found that he could take over the work of stores control, and the stores clerk returned to the stores subsection. In commenting on his absorption of stores control, the scheduling assistant pointed out that combining the two activities actually made the work of both easier.

The foreman's safety engineer spent one day a week in the motor assembly subsection. He did the same for each of the other three foremen who were operating large production subsections with the help of assistants. Weekly he spent his fifth day in whichever of the four production subsections happened to need him. One-fourth of his time was charged to each of the four foremen for whom he worked.

The motor assembly subsection originally was assigned a full-time trainer. As this assistant became intimately familiar with activities in the subsection, his work became less remedial in its character and for the most part became preventive. In this respect it resembled the work of the standards engineer. By watching workers, the trainer could identify situations that should be improved. He did not bring these situations to the attention of the foreman. Instead he promptly rectified the condition, working directly with the operator. Occasionally a worker went to the trainer for help. Usually it was the trainer who took the initiative. The foreman spent much of his time out in the department among the workers. The results of the training assistant's work rapidly became apparent. After five months the trainer and foreman agreed that the work no longer needed the full-time attention of the training assistant, and the foreman arranged with one of the three other autonomous foremen who did not have a training assistant to have the trainer divide his time between the two departments.

The foreman of the motor assembly subsection with the help of the equivalent of four full-time assistants was supervising the work of 83 people who originally had been more or less "bossed" by three foremen. These foremen had had available to them service from a dozen specialized functional sections and subsections. Typically a foreman spent one-third to one-half of his time negotiating with these functional specialists in an effort to obtain service from them. He had no authority over the service organizations, and the results he obtained for his own subsection depended substantially on his ability to persuade them to give him help when he needed it. He frequently was confronted with unkept promises from these functional subsection supervisors and section managers. As a result he himself constantly was unable to achieve fully what was expected of him. He became a master of alibi and an expert at double talk.

The foremen of the four new production subsections were essentially managers. Each was held fully accountable for the operations and costs of a self-sufficient production operation. Each had his own functional specialists—whatever assistants he needed to do his job—and each was held personally responsible for the performance of his subsection. The foreman of the motor assembly subsection was assisted by two inspectors, one methods and standards man who set job standards and rates, a trainer who spent half his time in the subsection, a one-quarter-time safety engineer, and a one-quarter-time maintenance man—the equivalent of four full-time people. The other three new unit-type subsection foremen likewise had assistants, the number depending upon the needs in the subsection. Each of the four foremen supervised a self-sufficient operating unit. Each operated with a monthly output and cost budget that showed actual performance of the subsection in comparison with predetermined standards. Each foreman supplied the vacuum cleaner department factory superintendent with an over-all monthly report and with weekly reports of output, labor hours, overtime, and the like. Each Monday morning the department's accounting section supplied each foreman with two copies of a report showing the earnings of each worker in his department for the previous week, the amount of overtime worked, the total production for the week, and a separate list of late orders. The foreman initialed one copy of this report and forwarded it to the factory superintendent.

In commenting on his situation the foreman of the motor assembly subsection said that he considered that he essentially was running a business of his own. He knew what was expected of him. He had full freedom in determining what assistance he needed. He selected his own helpers. He had trained them and had full authority over them. He spent almost no time on matters outside his own subsection. Most of his day he was either consulting with his assistants, studying reports, planning, or was out on the work floor. Worker relations was his most time-consuming job.

The foreman had expected that by spending much of his time with the workers, worker complaints and formal grievances would become rare. Actually the opposite resulted. Workers expressed more dissatisfactions to him than ever before. However, these tended to be more trivial than in the past. At first the foreman was worried about this, but as time went on he found that these complaints could be adjusted quickly. It became rare for a grievance to go beyond his own subsection. This was a decided change from his earlier experience when grievances commonly were referred by the foreman to the factory superintendent who, in turn, frequently found it necessary to pass them on up to the personnel section manager or the department general manager. Formal union grievances involving the union contract sometimes had reached the vice-president in charge of industrial relations before they were settled.

During the first six months of the foreman's management of the new unit motor assembly subsection, life for him had been hectic. He had found it necessary to work very long hours, and each day seemed to be just one succession of problems. It had taken time for his assistants to understand what it meant to have full authority, each within the range of his responsibility. It had taken time for them to learn how to work cooperatively with each other on problems that involved more than one of their functions. Probably the most difficult skill they had to develop was that of dealing effectively with the workpeople in the subsection. In all this it was the foreman who had provided the leadership, who coached his assistants, who saw to it that each understood the full nature of his responsibility and acquired the self-confidence and initiative that were essential to success. The foreman realized how fortunate he had been in having a large number of potential assistants from whom to select.

The foreman was especially impressed with the time it took the 83 workpeople in the subsection to learn to take their problems to the proper assistants. In the past they always had gone to the foreman. Now they found that if they did this the foreman only directed them to an assistant. It took time and experience for workers to adjust to the new system. However, they did adjust and it became rare for a worker to take a problem directly to the foreman. The change-over had been helped by the fact that the foreman was on the work floor much of the time. When a worker called his attention to a problem, the foreman usually would tell the worker to which of the foreman's assistants he should go for help. The presence of the assistants right in the subsection was an additional aid.

By year's end the foreman had a smooth-working team of assistants. Workers liked the arrangement. They did not always agree with the answers they received but, as the union steward in the subsection said, "You always can get an authoritative answer, and you can get it fast. The old days of delay and buck-passing are over."

The experience in the new motor assembly subsection was no different from that of the other three foremen of new unit-type subsections. For each it had been a struggle. But they all were ambitious and determined to make a success of the new opportunity. Each liked his new work, was enthusiastic about it. Each reported that he at last was "on top of the job" and that the job was both interesting and challenging. Each was receiving a salary between the pay of the factory superintendent and that of the highest paid general foreman. This amounted to an increase of over 50 per cent of the salaries they had received as foremen. In their new positions they were making a real contribution. They knew this and also knew that their superiors recognized their accomplishments. They had been told that the general manager of the department had agreed with the factory superintendent that with the start of the forthcoming year their titles were to be changed from foreman to subsection manager.

The factory superintendent was elated with the results of his experiment in organizational decentralization at the first-line supervisory level. Working in consultation with the four new subsection managers he had prepared estimates of what would be involved in extending the unit subsection concept throughout the factory. The following are highlights of his conclusions as he presented them to the department general manager.

The position of general foreman would be eliminated. The present 41 foremen would be replaced by 18 subsection managers who would report directly to the factory superintendent. Three functional subsections—the stores subsection, the inspection subsection, and the standards and methods subsection—would be discontinued. The safety section also would be eliminated. The maintenance subsection would be reduced from its present 11 specialists to two who would spend their entire time on general routine maintenance. The present worker training program in the personnel section would be greatly reduced. Three of its 16 trainers would be retained to develop training programs for the new subsection managers as needed and to help the training assistants in the production subsections develop their skills as trainers.

Fourteen more subsection managers would have to be found and trained. The factory superintendent concluded that some of these could be located among the younger foremen; he was not at all certain that all 14 could be recruited from that source. He was convinced that none of the general foremen would make effective subsection managers. They were "too old, and too set in their ways." There was some possibility that they could be absorbed in the remaining functional subsections and in some of the functional sections. He estimated a 40 per cent reduction of indirect labor in the sections and subsections effected by the change. He believed that the entire change-over could be accomplished in about five years.

QUESTIONS

1. Prepare an organization chart to show the effect of the four new unit subsections on the factory organization of the vacuum cleaner department of the Atlantic-Union Company. Page 640 shows the organization as it was prior to the creation of the four new subsections.
2. What are the strengths and weaknesses of the factory superintendent's subsection manager plan?
3. What problems should the management of the Atlantic-Union Company anticipate if it decides upon broad extension of the plan?
4. What steps would you suggest that the top management take if it decides to extend the plan?
5. Why did the factory superintendent believe that it would take five years to put the plan into operation throughout the vacuum cleaner department?
6. If you were the general manager of the vacuum cleaner department what, if any, further applications of the plan would you authorize the factory superintendent to make?

7. One vice-president of the Atlantic-Union Company remarked that, "The subsection manager concept introduced in the vacuum cleaner department is the logical conclusion of our whole decentralization program." What did he mean by this? Do you agree with him?

8. How do you explain the fact that although this type of organization at the first-line supervision level is quite prevalent in small businesses it rarely is found in large businesses?

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